The Australian Centre for International Agricultural Research (ACIAR) was established in June 1982 by an Act of the Australian Parliament. Its mandate is to help identify agricultural problems in developing countries and to commission collaborative research between Australian and developing country researchers in fields where Australia has a special research competence.

Where trade names are used this constitutes neither endorsement of nor discrimination against any product by the Centre.

ACIAR PROCEEDINGS

This series of publications includes the full proceedings of research workshops or symposia organised or supported by ACIAR. Numbers in this series are distributed internationally to selected individuals and scientific institutions. Recent numbers in the series are listed inside the back cover.

G.P.O. Box 1571, Canberra, A.C.T. 2601
Campbell, H., Menz, K., and Waugh, G. 1989. Economics of fishery management in the Pacific Islands region: proceedings of an international conference held at Hobart, Tasmania, Australia, 20–22 March 1989. ACIAR Proceedings No. 26, 169 p.

ISBN 0 949511 95 1
Technical editing: Reginald MacIntyre
Typeset and laid out by: Press Etching (Qld) Pty Ltd, Brisbane
Printed by: Roden Print Pty Ltd, Silverwater, N.S.W. 2141
Cover Photo: Kevin McLoughlin

ECONOMICS OF FISHERY MANAGEMENT IN THE PACIFIC ISLANDS REGION

Proceedings of an international conference held at Hobart, Tasmania, Australia, 20–22 March 1989

Editors: **H. Campbell, K. Menz and G. Waugh**

Collaborating Institutions:
Department of Economics, University of Tasmania
Australian Centre for International Agricultural Research
Department of Economics, University of New South Wales

Economics of Fishery Management in the Pacific Islands Region

Contents

Management and Development

Research and Development Strategy

Participants 167

Foreword

In his remarks to officially open this conference, Professor Alec Lazenby, the Vice-Chancellor of the University of Tasmania, emphasised the importance of fisheries to the South Pacific Islanders, and the need for economic research to find ways of increasing the contribution of fisheries to the economy of the region.

The South Pacific Island representatives made their own statement at the conference in which they expressed their appreciation of ACIAR's efforts in supporting this timely workshop on fisheries economics, which they felt is a critical element in fisheries management and development in the Pacific Islands region. Their statement continued: "Each Island country has its own priorities in fisheries development. In addition, the needs for economic assistance in fisheries are different in each Island country. For this reason, research priorities in fisheries economics must be determined by individual countries. As such, it is recommended that ACIAR pursue this issue on a bilateral basis with individual Island governments with the understanding that the Forum Fisheries Agency might be called upon by any of its member countries to assist. In addition, Pacific Island countries represented would like to emphasise the need for applied practical research and appropriate training in fisheries economics. Results from research must have direct benefit to Island countries."

ACIAR's mandate and style of operation are consistent with the views expressed, and we fully recognise the uniqueness of each country and their development goals. With this in mind ACIAR plans to explore further the questions posed at this workshop, with the possibility of developing research projects that can address some of the problems identified.

ACIAR is grateful to the individual Pacific Island representatives for their participation, and to representatives from the Forum Fisheries Agency, the South Pacific Commission, and to the Australian, Japanese and Canadian researchers who participated and contributed their extensive knowledge about South Pacific fisheries and the relevant economic issues.

We would like to thank the following people for organising the workshop and helping to ensure its success: Harry Campbell, Sue Abel and Michael Buchanan, University of Tasmania; Geoff Waugh, University of New South Wales; and Pamela Chapman of ACIAR.

J.R. McWilliam
Director
ACIAR

Introductory Paper

Pacific Islands Fishery Management: an Economic Overview

H.F. Campbell[1] and G. Waugh[2]

Introduction

THE fisheries of the Pacific region fall readily into two groups. The large-scale offshore tuna fisheries are dominated by capital-intensive harvesting techniques, such as purse-seine, long-line, and pole-and-line, and by capital-intensive processing and distribution networks. The small-scale inshore fisheries, operating around the lagoons and reefs of the islands of the region, are relatively labour-intensive with more simple market networks. Some of the tuna stocks are capable of further development whereas many of the inshore species are already under heavy pressure. For most Pacific Island countries harvesting and processing tuna involves a massive capital outlay relative to their resources. Inshore fisheries, on the other hand, often operating with traditional methods, fit more readily into the present economic structure. The balance between inshore and offshore fisheries varies from country to country, depending on natural and cultural as well as economic factors.

Fisheries management and development in the region is a complex matter involving techniques and approaches drawn from a number of disciplines. Assessment of offshore and inshore stocks is conducted by biologists. Property rights to fish stocks are analysed by lawyers in the case of offshore stocks and by experts on traditional island cultures and economies in the case of inshore stocks. Economists provide analyses of the cost and benefits of harvesting, processing and marketing alternatives. The wealth of information and analysis available in these matters is illustrated by the papers presented at the Conference; by the references cited in those papers; and by the extensive bibliography which was assembled during the planning of the Conference and which is appended to this introductory paper.

From the viewpoint of each Pacific Island State the question is how this mass of analytical and descriptive material can be brought to bear in a meaningful and practical way on its own unique problems and opportunities for development. How can it assert its rights to tuna stocks in its Exclusive Economic Zone? What should be the level of its participation in the exploitation of these stocks now and in the future? What is a fair return on stocks exploited by foreigners? What institutional arrangements are best for allocating rights to the stocks between domestic and foreign concerns? How can access to markets and a fair price for the harvest be achieved?

[1] Department of Economics, University of Tasmania, GPO Box 252C, Hobart, Tas 7001, Australia.

[2] Department of Economics, University of New South Wales, PO Box 1, Kensington, NSW 2033, Australia.

What effect does the exploitation of the offshore stocks have on inshore stocks? Should traditional inshore fisheries be supplemented by aquaculture and mariculture? Can new markets be developed for the products of inshore fisheries? Can fisheries make a significant contribution to economic development?

Review of the Papers

The creation of the 200-mile Exclusive Economic Zone has given the rights of ownership to the Pacific nations, but has left harvesting and processing largely in the hands of the developed Western economies. **Munro** outlines more recent developments since the creation of 200-mile zones. Benefits, he argues, lie in an understanding of the nature of comparative advantage for harvesting and processing, and in having a clear idea how comparative advantage may shift through time. He further argues that gains must come not only through regional cooperation in the Pacific, but also through interregional cooperation between the South Pacific Forum, member countries of ASEAN and Pacific Latin American countries.

The gains to be derived depend on how private industry cooperates. **Doulman** takes a more specific look at the problems for Pacific countries in the tuna harvesting and processing industry. Given the degree of capital shortage in the small Pacific Island states he sees joint ventures as an appropriate way of securing domestic benefits. Doulman laments the fact that past joint ventures have not secured the expected gains for Pacific countries. Pacific governments, he argues, have been unable effectively to participate in the direction of such joint ventures, and the record is that in the Pacific there has been little gain to the Pacific Islands themselves. He proceeds to outline alternative structures for joint ventures with a view to stimulating further research in this area.

Fisheries are biologically driven. **Kearney** turns attention to the biological management of the tuna fisheries. Of the four major species fished, only skipjack shows significant potential for increased catches, although Kearney warns against underestimating the impact heavy fishing may have on localised fish populations. Data on yellowfin are still too limited to make firm predictions about catch rates, however, it is a resource which is prone to 'fisheries-induced declines.' He calls for greater complexity in the economic analysis required to evaluate 'optimum' fishing effort where yellowfin caught by purse-seining and long-line methods yield highly different monetary benefits. Of the two other major species, albacore has come under recent threat with intense competition between troll and surface gill-net fisheries, while little is known of the bigeye tuna resources. Kearney again draws attention to the need for regional management of the resource.

The paper by **Tsamenyi and Blay** is a wide-ranging one. In the main the paper deals with the current state of implementation of the new Law of the Sea in the Pacific, and addresses legal issues, enforcement issues, the potential for economic gains and the nature of multilateral access agreements. The authors comment on the fact that joint ventures appear to have been a singularly unsuccessful method of securing gains for the Pacific Island states from exploiting their newly proclaimed zones.

Turning to small-scale inshore fisheries, it is the variety of tenure systems that may intrigue Western economists. **Ruddle** draws attention to sole ownership of specific fishing areas by individuals, clans or other small groups. He argues that close examination of the relationship between resources and these societies indicates a custodial rather than a possessive attitude of people towards their resources. This position appears to be the antithesis of fisheries in Western systems. **Scott** examines

the evolution of Individual Transferable Quotas as a form of property right. Such a property right reflects a person's interest in the fishery in terms of a number of characteristics that can be used to define the extent of that right. At the present time ITQs lack some of the characteristics which are necessary for collective management of natural resources. Traditional custodial rights, on the other hand, are fairly comprehensive but are vulnerable to commercial pressures.

Johannes contrasts the 'customary marine tenure' system with limited entry as it evolved in developed economies. He notes that both systems of management may aid preservation of resources in the Pacific, and points out that the question is one of deciding when and where either is appropriate. Small-scale inshore fisheries have not been studied in great detail by economists, and management has been left to biologists and sociologists. Indeed it is an open question whether Western-trained economists can provide significant help here. Johannes notes that to anyone raised in a society where the accumulation of wealth is the prime mover in economic affairs it may come as a shock to learn that in many traditional Pacific Island societies it is unimportant. Further, he notes that commercial fishing holds little appeal as a full-time occupation for many islanders, a factor which suggests that Western methods of organising fishing may not be suitable. The objective of maximising yield or economic returns may not be appropriate for the small-scale fisheries in this region. Rather the concern may well be with minimising ecological, economic and social stress.

Despite these concerns about traditional values there is a need for adequate surveys before, and if, development initiatives are taken. **King and McIlgorm** highlight the issues. Surveys of species, catch rates and suitable fishing gear are required, along with analysis of the market, economic and financial feasibility of expanding the fishery. The complexities of these surveys in tropical fisheries far exceed those of temperate water counterparts. Yields are difficult to estimate, markets are insecure, and transport and refrigeration inadequate.

Whereas sustainable yields of exploited stocks provide the information necessary for estimation of supply, it is the availability of markets that determines the viability of a well-managed fishery. **Owen** suggests ways economic and econometric theory can be used to understand the nature of fisheries markets when it is possible to abstract from the complexities of real world markets. Tuna markets are in many ways very suitable for this type of modelling. The markets are well established, and data on prices and quantities sold are available and published. A first step in bringing this information into estimable form is the establishment of a comprehensive data bank of information that will allow the key socioeconomic determinants of demand to be identified and quantified.

Penetration of established markets is often a very difficult task. **Williams** discusses the issues. A key to understanding markets of this type relates to the need to recognise changes and the trends that are taking place. Changes in consumers' incomes and lifestyles lead to new needs and wants, and provide opportunities for exporters of fisheries products to establish a niche in existing markets. Indeed, fisheries management must extend beyond supply side factors of sustainable yield, and respond to the need to investigate markets and distribution channels.

Case studies of fisheries management provide an important starting point in a review of fisheries resources in the Pacific. **Vonole** discusses management issues in the highly developed PNG prawn fishery. This fishery has been commercial since 1967 with most of the production being exported to Japan. This fishery is not a traditional fishery, it has a complex management plan, and Western-style fisheries regulations. In 1983 joint venture arrangements were terminated, and the industry nationalised. **Takendu** provides details of the markets for PNG prawns. He finds

that just over 7% of catch is consumed domestically, predominantly in Port Moresby. He argues that an understanding of the linkages within the fisheries sectors will aid policy formulation.

Reipen and Kenneth discuss the history and future of fisheries in the Republic of Vanuatu. Fishing activities in Vanuatu have been mainly subsistence in nature with harvesting confined largely to inshore reefs and lagoons. The only large-scale commercial activity has centred on the transshipping facilities in Palekula: initially the Government had 7% equity, but subsequently acquired total ownership. Reipen and Kenneth question the wisdom, in the short term, of Vanuatu following the path of other Pacific nations and developing a nationally owned offshore fishing fleet, although they still see this objective as a long-term goal.

Also dealing with tuna, **McIlgorm** provides a case study of a different style. Basically tuna is a demand-driven industry; international demand for the final product is the driving force that allows high prices to be obtained for Pacific tuna. The harvesters have been mainly Japan, United States, Taiwan and Korea with other countries lacking the experience and information necessary to assess investment opportunities. There is a need for computerised techniques to allow easy assessment of the expected financial flows for those countries which would wish to extend their capacity to harvest tuna. Taking one such example from Australia, McIlgorm illustrates the procedures.

Both the offshore fisheries and the inshore fisheries offer significant potential areas for development and research. A third possibility for fisheries development in the Pacific is provided by new advances in aquaculture and mariculture. Unfortunately, to date, aquaculture has provided only a few success stories. The economic possibilities are limited, and comparisons with Asia, where markets are large and transport to large cities relatively cheap, are inappropriate. **Uwate** discusses four case studies which illustrate the need for careful planning and economic research. The first describes the economic rationale for management of the Yap State trochus fisheries in the Federated States of Micronesia. The second relates to milkfish farms in Tarawa, Kiribati, and illustrates how marketing and knowledge of the target market can improve revenues. The third describes how an economic analysis of Fish Aggregating Devices (FADs) aided funding proposals in Palau. And the final study from Guam demonstrates the usefulness of economic planning for aquaculture development.

Tisdell describes the current status of the economic research currently under way in the mariculture of giant clams. Both from a demand and a supply perspective the industry is in its infancy. On the demand side there is an existing but limited market for clams in the aquarium and restaurant trades. On the supply side the south Pacific is well suited to provide major areas of production, especially in the light of the severe constraints placed on mariculture of clams by the need for unpolluted waters.

When viewed in total, it is readily apparent that the question of appropriate economic research for fisheries in the Pacific region remains unresolved. Two quite divergent papers are provided here. **Brown and Waugh** attempt to open up the whole question. They argue that microeconomics might provide an appropriate framework for analysis of fisheries in Western society, but such a framework is one of many. In general an appropriate framework must recognise, explicitly, social and cultural features, since any model reflects a particular world view. Their argument is that free-trade models, currently used in most fisheries economic model building, may simply be inappropriate in this context, and they suggest that vulnerability minimisation may be more appropriate when complex social, biological and economic systems need to be preserved. Their argument fits into the scheme of things envisaged by Johannes and by Ruddle.

Lindner shows clearly and elegantly the economic gains to be had from management and research in fisheries. He reminds us that research is an investment activity and that funds should be allocated to maximise their expected net benefit. One of the most important determinants of potential benefits from research on a fishery is the management system to be practiced in the fishery.

Conclusion

In the final analysis it is the offshore tuna fisheries which hold the key to the greatest financial gains for the Pacific peoples; and it is the large costs of exploiting this resource, coupled with the difficulties of designing joint-venture schemes, that provides the barriers to reaping these gains. Traditional inshore fisheries can, if properly managed, provide for local consumption and employment in coastal areas. Mariculture and aquaculture in some cases may provide prospects for increasing these benefits. An emerging view is that an integrated approach to the biological, economic and social aspects of fisheries in the South Pacific would help significantly.

Bibliography

Aikman, C.C. 1987. Island Nations of the South Pacific and Jurisdiction Over Highly Migratory Species. V.U.W.L.R.

Bell, C., and Sussangkarn, C. 1988. Rationing and Adjustment in the Market for Tenancies: The Behaviour of Landowning Households in Thanjavur District. American Journal of Agricultural Economics, November.

Byron, N., and Waugh, G. 1988. Forestry and Fisheries in the Asian-Pacific Region: Issues in Natural Resource Management. Asian-Pacific Economic Literature, 2(1), March, 46–80.

Campbell, H.F. (forthcoming). Resource Rent Rivalry in the Western Pacific Tuna Fishery: Cooperative and Non-cooperative Solutions. Journal of Ocean and Shoreline Management.

Campbell, H.F., and Lindner, R.K. (forthcoming). A Note on Optimal Effort in the Maldivian Tuna Fishery. Marine Resource Economics.

Carleton, C. 1983. Miscellaneous Marine Products in the South Pacific: A Review of Available Marketing Information. Forum Fisheries Agency of the South Pacific, February, 61 p.

Clark, L. 1983. A Study on Fees and Other Economic Benefits from Foreign Fishing Access to the Fisheries of Exclusive Economic Zones of the States Participating in the South Pacific Forum Fisheries Agency. In Report of the Expert Consultation on the Conditions for Access to the Fish Resources of the Exclusive Economic Zones, FAO Fisheries Report 293, Annex 8, 111–124.

1984. Fisheries Issues in the Pacific Islands. In International Institute of Fishery Economics and Trade, Proceedings of 2nd Conference, 1, 19–26.

1984. UNCLOS, The Pacific Island States. The Courier, May/June 1984, No. 35.

Clarke, F.H., and Munro, G.R. 1987. Coastal States, Distant Water Fishing Nations and Extended Jurisdiction: A Principal-Agent Analysis. Natural Resource Modelling, 2(1) Summer, 81–107.

Comitini, S., and Hardjolukito, S. 1986. Economic Benefits and Costs of Alternative Arrangements for Tuna Fisheries Development in the Exclusive Economic Zone: the Case of Indonesia. Ocean Management, 10, 37–55.

Comitini, S., and Huang, D.S. 1971. Licensing and Efficiency: an Empirical Study of the Japanese Tuna-Fishing Industry. Malayan Economic Review, 16, 76–83.

Crough, G.J. 1987. The Development of the Tuna Industry in Thailand. Pacific Islands Development Program, East-West Center, Honolulu, xiv + 34 p.

Crutchfield, S.R. 1983. Estimation of Foreign Willingness to Pay for United States Fishery Resources: Japanese Demand for Alaska Pollock. Land Economics, 59(1) February, 16–23.

Djalal, H. 1983. Implementation of Agreements with Foreigners. In Report of the Expert Consultation on the Conditions for Access to the Fish Resources of the Exclusive Economic Zones, FAO Fisheries Report 293, Annex 10, 129–141.

Doulman, D.J. 1985. The Tuna Industry in the Pacific Islands Region: Opportunities for Foreign Investment. Pacific Islands Development Program, East-West Center, Honolulu, 24 p.

1986. Fishing for Tuna: The Operation of Distant-Water Fleets in the Pacific Islands Region. Pacific Islands Development Program, East-West Center, Honolulu, iv + 30 p.

1987. Licensing Distant-Water Tuna Fleets in Papua New Guinea. Marine Policy, January, 16–28.

1987. The Development of the Tuna Industry in the Pacific Islands Region: An Analysis of Options (Honolulu: East West Center) pp xviii + 416.

1987. Tuna Issues and Perspectives in the Pacific Islands Region. East-West Center, Honolulu, xiii + 314 p.

Doulman, D.J., and Kearney, R.E. 1986. The Domestic Tuna Industry in the Pacific Islands Region. Pacific Islands Development Program, Research Report Series No. 7, East-West Center, Honolulu, xi + 75 p.

FAO. 1983. General Guidelines for Monitoring, Control and Surveillance. In Report of the Expert Consultation on the Conditions for Access to the Fish Resources of the Exclusive Economic Zones, FAO Fisheries Report 293, Annex 12, 153–156.

Forum Fisheries Agency. 1985. The Purse Seine Financial Appraisal Model. FFA Report, 85/27.

Fujinami, N. 1983. The Japanese Experience in Access Conditions of 200 Mile Regime. In Report of the Expert Consultation on the Conditions of Access to the Fish Resources of the Exclusive Economic Zones, FAO Fisheries Report 293, Annex 14, 175–182.

Gates, J.M. 1983. Foreign Access Benefits in Fisheries. Report of the Expert Consultation on the Conditions for Access to the Fish Resources of the Exclusive Economic Zones, FAO Fisheries Report 293, Annex 7, 101–109.

Green, G., and Nayar, N. 1988. Individual Transferable Quotas in the Southern Bluefin Tuna Fishery: an Economic Appraisal. Advanced Research Workshop on the Scientific Foundations for Rights Based Fishing, Reykjavik, 24 p.

Hillborn, R. 1987. Spatial Models of Tuna Dynamics in the Western Pacific: Is International Management Necessary? Marine Policy, January, 31–39.

Hutton, G. 1984. Tuna Purse Seining Technology in the West Pacific. Forum Fisheries Agency, Workshop on National Tuna Fishing Operations, May 28–June 2.

Joseph, J. 1973. Scientific Management of the World Stock of Tuna, Billfishes, and Related Species. Journal of the Fisheries Research Board of Canada, 30(12), Pt. 2, 2471–2482.

1977. The Management of Highly Migratory Species. Marine Policy, October, 275–288.

Joseph, J., and Greenough, J.W. 1979. International Management of Tuna, Porpoise, and Billfish. University of Washington Press, Seattle, xv + 253 p.

Karnasuta, J. 1987. The Tuna Industry and the ASEAN Region. In ASEAN-Pacific Island Nations International Fisheries Conference, Pacific Economic Cooperation Conference (PECC), Manila, 34–59.

Kearney, R.E. 1980. Some Problems of Developing and Managing Fisheries in Small Island States. In The Island States of the Pacific and Indian Oceans: Anatomy of Development, R.T. Shand (ed.) Development Studies Centre Monograph 23, Australian National University, Canberra.

Kent, G. 1980. The Politics of Pacific Island Fisheries. Westview Press, Boulder, Colorado, ix + 191 p.

King, D.M. 1979. International Management of Highly Migratory Species — Centralized Versus Decentralized Economic Decision Making. Marine Policy, October, 3(4), 264–277.

Lawson, R.M. 1980. Development and Growth Constraints in the Artisanal Fisheries Sector in Island States. In The Island States of the Pacific and Indian Oceans: Anatomy of Development, R.T. Shand (ed.) Development Studies Centre Monograph 23, 61–85, Australian National University, Canberra.

Leviste, Jr., J.P., and Baluyut, E.A. 1987. The Fisheries of the Asean and Pacific Island Nations: an Overview. In ASEAN-Pacific Island Nations International Fisheries Conference, Pacific Economic Cooperation Conference (PECC), Manila, 34–59.

Marten, G.G., Matsuda, Y., Bardach, J., Comitini, S., and Hardjolukito, S. 1982. A Goal Analysis of Alternative Tuna Fishery Arrangements Between Indonesia and Japan. Ocean Management, 8, 125–150.

Munro, G.R. 1983. Foreign Access to EZZs and the Derivation of Coastal State Benefits: Methods and Techniques. In Report of the Expert Consultation on the Conditions of Access to the Fish Resources of the Exclusive Economic Zones, FAO Fisheries Report 293, Annex 11, 143–151.

1985. Coastal States, Distant-Water Fleets and EFJ — Some Long-Run Considerations. Marine Policy, January 1985, 2–15.

1987. The Management of Shared Fishery Resources Under Extended Jurisdiction. Marine Resource Economics, 3(4), 271–296.

1988. International Cooperation for Resource Management: Fisheries. Discussion Paper 88–08, Department of Economics, The University of British Columbia, Canada, 61 p.

Robb, D. 1983. Access Conditions and Compliance Control. In Report of the Expert Consultation on the Conditions of Access to the Fish Resources of the Exclusive Economic Zones, FAO Fisheries Report 293, Annex 13, 157–173.

Ruddle, K. 1988. The Organization of Traditional Inshore Fishery Management Systems in Asia and the Pacific. Advanced Research Workshop on Scientific Foundations of Rights-Based Fishing, Reykjavik, June, 41 p.

Sathiendrakumar, R., and Tisdell, C. 1986. Fishery Resources and Policies in the Maldives. Marine Policy, October, 279–293.

1987. Optimal Economic Fishery Effort in the Maldivian Tuna Fishery: an Appropriate Model. Marine Resource Economics, 4, 15–44.

Shyam, M.R. 1982. The New International Economic Order and the New Regime for Fisheries Management. Ocean Management, 8, 51–64.

South Pacific Commission. 1988. Workshop on Pacific Inshore Fishery Resources. Inshore Fisheries Research Project, Noumea, 15 p.

1988. Methods of Studying Fishery Interaction. Information Paper 5, 14.

Stokes, R.L. 1981. The New Approach to Foreign Fisheries Allocation: An Economic Appraisal. Land Economics, 57(4), 568–582.

Tsamenyi, B.M. (forthcoming). The Treaty on fisheries Between the Government of Certain Pacific Islands States and the government of the United States of America: The Final Chapter in United States' Tuna Policy. Brooklyn Journal of International Law.

1986. The South Pacific States, the USA and Sovereignty over Highly Migratory

Species. Marine Policy, January, 29–41.

1986. Legal Aspects of Fisheries: the Need for Legal Training Facilities in the South Pacific. AMBIO, 15(6), 351–353.

1986. The Jeannette Diana Dispute. Ocean Development and International Law, 16(4), 353–367.

1988. The Exercise of Coastal State Jurisdiction Over EEZ Fisheries Resources: The South Pacific Practice. AMBIO, 17(4), 255–258.

Van Dyke, J., and Heftel, S. 1981. Tuna Management in the Pacific: An Analysis of the South Pacific Forum Fisheries Agency. University of Hawaii Law Review, 3, 1–65.

Waugh, G. 1986. The Development of Fisheries in the South Pacific Region, With Reference to Fiji, Solomon Islands, Vanuatu, Western Samoa and Tonga. Islands/ Australia Working Paper 86/2, National Centre for Development Studies, Australian National University, 34 p.

1987. The Collection of Rent in the South Pacific Tuna Fishery. Islands/ Australia Working Paper 87/3, National Centre for Development Studies, Australian National University, 39 p.

1988. Development, Economics and Fishing Rights in the South Pacific Tuna Fishery. Advanced Workshop on Scientific Foundations for Rights Based Fishing, Reykjavik, Iceland, June 27–July 1, 30 p.

1988. Trends in the Western Pacific, Eastern Pacific, Indian and Atlantic Ocean Fisheries. South Pacific Forum Fisheries Agency, FFA Report 88/27, Honiara, Solomon Islands.

1988. World Trends in the Demand and Supply of Tuna: Summary Paper. South Pacific Forum Fisheries Agency, FFA Report 88/28, Honiara, Solomon Islands.

1988. Trends in the U.S., European and Japanese Tuna Markets. South Pacific Forum Fisheries Agency, FFA Report 88/1, Honiara, Solomon Islands.

Waugh, G., and Brown, J. 1988. Strategies for the Development of Fisheries Policy in the South Pacific. The Australian and the South Pacific Conference, University of New South Wales, December.

The Tuna Industry in the South Pacific

The Pacific Islands, the Law of the Sea and Pacific Tropical Tuna

Gordon R. Munro[1]

Abstract

This paper discusses the South Pacific tuna industry in the context of the tuna industry of the Pacific as a whole. The South Pacific tuna industry cannot be examined in isolation. The other tuna industries in the Pacific are obviously in competition with that in the South Pacific. Yet there also exist important opportunities for cooperation and collaboration between the South Pacific industry and the others of the region. The economic research opportunities arising from these intra-regional linkages are discussed.

Introduction

IT is commonplace to state that the tuna fishing industry of the Pacific Islands region has been profoundly affected by the Third U.N. Conference on the Law of the Sea and by the Law of the Sea Convention arising from that Conference. Indeed, the development and evolution of the tuna industries of the Pacific Islands, which provide the focus of this Conference, can be seen as a part of the process of implementing the Law of the Sea Convention.

What is less obvious is the fact that the aforementioned development and evolution are not occurring in isolation. There are other major tropical tuna industries in the Pacific, dominated by developing coastal states, which have also been heavily influenced by the Third Law of the Sea Conference. These are, in particular, the tuna industries of the members of the Association of Southeast Asian Nations (ASEAN) and the tuna industries of the eastern Pacific, from Mexico to northern Chile.

In this paper, I will trace the impact of the aforementioned Law of the Sea Conference upon these other tropical tuna industries, as well as upon those of the Pacific Islands, and discuss the economic interactions which have occurred and are likely to occur among these industries.

Some questions that these developments raise are posed, which bear directly upon the future progress of the Pacific Islands tuna industry. No answers are offered, as the answers cannot be obtained without substantial additional research that is beyond the scope of this paper.

Pacific Tropical Tuna Fisheries Prior to the Third U.N. Conference

Tropical tuna and tuna-related harvests in the three major regions of the Pacific in the mid-1980s were (in thousands of tonnes): Pacific Islands 645, eastern Pacific 255, and ASEAN 658 (data from Food and Agriculture Organization of the U.N., Yearbook of Fishery Statistics 1985, Vol. 60, Rome, 1987; South Pacific Forum Fisheries Agency).

The Pacific Islands and the ASEAN fisheries appear to be roughly equal in magnitude, but the statistics are in fact somewhat misleading. Commercially, the tuna fisheries can be divided into those based upon the so-called principal market species, and those based upon secondary or inferior species. The principal market species, relevant for

[1] Department of Economics, University of British Columbia, 997–1873 East Mall, Vancouver, B.C., Canada V6T 1W5.

Pacific tropical tuna fisheries, are skipjack, yellowfin, bigeye and albacore. The Pacific Islands and eastern Pacific harvests are dominated by principal market species. In the ASEAN fisheries, on the other hand, principal market species account for roughly 35% of the harvests, the remaining 65% being accounted for by secondary species. Thus, the Pacific Islands can be viewed as the leading region for Pacific tropical tuna fisheries, followed by the eastern Pacific and the ASEAN.

If one were to return to the dawn of the Third U.N. Conference on the Law of the Sea (referred to hereafter as UNCLOS III) in the early 1970s, one would have found the Pacific Islands region leading in Pacific tropical tuna fisheries, followed by the eastern Pacific. The ASEAN region, however, would barely register.

Thus, to all intents and purposes, Pacific tropical tuna fisheries was bi-regional. The two regions combined accounted for 60–70% of the world's harvest of tuna (Saila and Norton 1974, p. 10). With only slight exaggeration, one could have described the tuna fisheries in the two regions as developed country preserves.

The tuna resources in both regions were concentrated offshore and constituted international common property. They were thus open to exploitation by distant water fishing nations. Two such nations were of paramount importance, Japan and the United States. Japanese fleets dominated the Pacific Islands region tuna fisheries, and accounted for in excess of 50% of the tuna harvests for the entire Pacific. The American fleets dominated the eastern Pacific and accounted for just under 30% of total Pacific harvests (Saila and Norton 1974, p. 10). The remaining harvests of Pacific tuna were accounted for by other distant water fishing nations, Taiwan and South Korea in particular.

The Japanese and Americans in turn dominated the processing and consumption of tuna. The Japanese accounted for just over 30% of the world consumption of tuna largely in the form of sashimi. The Americans accounted for just under 45% of world consumption, largely in the form of canned tuna. The remainder of the world consumption of tuna was accounted for almost entirely by Western Europe (Saila and Norton 1974, p. 28).

The nature of the composition of Pacific tuna harvesters reflected the fact that the fisheries were offshore and involved the targeting of a highly migratory species. Hence the operations were capital-intensive with the comparative advantage thus tending to lie with developed coastal states. The concentration of the market in developed countries was a reflection, both of the costs of harvesting and processing, and of the high income elasticity of demand for tuna products (Saila and Norton 1974, p. 28).

While the harvested fish from the two regions competed in the world markets, the regions could have been regarded as virtually separate. There appears to be little firm evidence that the fisheries of the two regions were linked biologically. Although Japanese vessels were to be found in the eastern, as well as western, Pacific, one would have difficulty in arguing that the fisheries of the two regions were linked by systematic fleet movements.

Management of tuna resources in the two regions differed markedly. The tuna fisheries in the Pacific Islands were the object of research by a regional organisation, the South Pacific Commission (SPC), which had as members the relevant colonial powers, e.g. France, U.K., U.S., as well as Island states. The fisheries were also subject to review by the FAO-sponsored Indo-Pacific Fisheries Commission (IPFC). It could not, however, be said that there were serious efforts at resource management in the region (Joseph and Greenough 1979, p. 20).

In the eastern Pacific, by way of contrast, there existed an international body designed both to undertake major tuna research programs and (through member governments) to exert management control over the resources. The body was the Inter-American Tropical Tuna Commission (IATTC).

In the eastern Pacific, the so-called tuna resource adjacent nations are divided into primary and secondary tiers. The primary tier consists of Mexico, Costa Rica and Ecuador; the secondary tier of Panama, Colombia and Peru. The IATTC was established in 1949 as a result of a treaty between the United States and a primary tier country, Costa Rica. Membership in the IATTC was open to all interested parties, and by the mid-1960s all primary tier nations were members, along with Panama. In due course, Japan and France, as distant water nations, joined.

The IATTC research programs commenced soon after the establishment of the Commission. Upon the urging of IATTC scientists in the early 1960s, the IATTC undertook serious attempts to conserve the major tuna species of the region, yellowfin.

The differences between the two regions with respect to management reflected in part the differences in species mix. Whereas yellowfin was the dominant species in the eastern Pacific, skipjack was dominant in the western Pacific. In contrast to yellowfin, skipjack was and is deemed to be abundant and not threatened with overfishing.

The IATTC management policy itself consisted of what was then the standard practice of global harvest quotas, accompanied by no control over fleet capacity. The outcome was predictable. Excess fleet capacity emerged. In the decade after the introduction of TACs, an increase of allowable harvests of 80% was accompanied by an increase in fleet capacity of over 280%. Per season, per boat harvests plummeted (Joseph and Greenough 1979, p. 15-17).

Although two South American countries, Ecuador and Peru, attempted to lay claim to tuna and other fishery resources out to 200 miles, there was no question that, in the pre-UNCLOS III era, distant water nations exerted influence over resource management within the IATTC. Legally, they were co-equal with the resource adjacent nations in the Commission. In fact, it is difficult to escape the impression that the single most important influence over IATTC-sponsored resource management policy was the United States. We repeat our assertion that, in the eastern, as well as western, Pacific, the tuna fisheries were largely developed country preserves.

UNCLOS III and the Tuna Issue

UNCLOS III officially commenced in December 1973, and held its concluding session in December 1982. As indicated, the Conference gave rise to a convention, the Law of the Sea Convention. The Convention has yet to be ratified by a sufficient number of countries to achieve the status of international treaty law. Indeed, it may never achieve that status. Nonetheless, that part of the Convention pertaining to fisheries, Part V the Exclusive Economic Zone, has gained such wide acceptance throughout the world that it can be said to lay down many of the fundamental rules of the game for world fisheries management.

While Part V of the Convention has gained wide acceptance, and while the concept of the Exclusive Economic Zone has achieved the status of customary international law (McRae and Munro 1988), the 'rules of the game' pertaining to tuna management were left in a state of some confusion at the end of the Conference and are only just now being resolved.

UNCLOS III made a distinction between highly migratory and non-highly migratory species. Of the highly migratory species, the most prominent were the tuna species.

The decisions arrived at in the Conference with regard to the non-highly migratory species proved in the end to be of direct and immediate relevance to the highly migratory species. I will consider briefly, therefore, the debate in the Conference over the non-highly migratory species.

It was agreed early on that coastal state jurisdiction over non-highly migratory species should extend out to 200 miles from shore. The debate was over the extent of coastal state property rights to these resources. One school of thought, supported by the United States, and for a time by others such as Canada, can be referred to as the custodial/preferential school (McRae and Munro 1988). Under this approach, the coastal state would act as custodian for the international community. It would design management schemes for the fishery resources within its zone, but it would not have clear-cut property rights to the resources.

As a reward for its management activities, the coastal state would be given preferential harvesting rights to the resources. Upon establishing a TAC for a fishery in its zone, the coastal state could proceed to take as much of the TAC as its harvesting capacity would permit. If the coastal state could not take the entire TAC, a 'surplus' would be deemed to exist. The coastal state would be obliged to grant other states, e.g. distant water fishing nations, access to these surpluses under non-onerous terms.

The opposing school of thought, which can be referred to as the Exclusive Economic Zone school, maintained that a coastal state should have full property rights to the fishery resources within its zone. This position was supported by developing coastal states, certainly including those in the Pacific. In point of fact, some of the Pacific South American countries, e.g. Ecuador and Peru, felt that the EEZ concept did not go far enough and argued that the coastal states should be given territorial seas out to 200 miles.

In any event, the Exclusive Economic Zone school won a clear-cut victory in the Conference. This is made evident by Article 56 in the Law of the Sea Convention, the key article in Part V. The article reads in part:

In the exclusive economic zone, the coastal

> State has sovereign rights for the purpose of exploring and exploiting, conserving and managing the natural resources, whether living or non-living...

It is true that there remains some flavour of the custodial/preferential approach in a subsequent article, Article 62, which calls upon the coastal state to measure its harvesting capacity against the TACs set for fisheries within its EEZ. Where the coastal state is unable to harvest a full TAC, a surplus is deemed to exist and the coastal state is obliged to grant other states, i.e. distant water fishing nations, access.

It can, however, be argued that the so-called 'surplus principle' is largely empty, at least in economic terms (McRae and Munro 1988). The previous article, Article 61, allows the coastal state almost unlimited power in setting TACs. Furthermore, Article 62 itself grants the coastal state very broad powers in imposing terms and conditions of access to the EEZ upon distant water fishing nations seeking the right to harvest surpluses. Most emphatically, the coastal state is not required to grant free acess to these 'surpluses.'

The Americans continued for a time to cling to the custodial/preferential approach. Yet even they finally accepted the EEZ concept, as made evident by a Presidential Proclamation in 1983. (United States EEZ Proclamation of March 10, 1983; Weekly Compilation of Presidential Documents, 384).

While the non-highly migratory species issues were resolved shortly after the conclusion of the Conference, the same could not be said about highly migratory species matters. To distant water fishing nations engaged in harvesting tropical tuna, the claim that coastal states should be able to lay claim to tuna resources off their coasts seemed particularly radical. The tuna fisheries had, after all, been developed by distant water fishing nations and were still dominated by them.

Led by the United States, the distant water fishing nations argued that, by virtue of being highly migratory, it was wholly inappropriate that these fishery resources should be subject to coastal state control. In fact, the argument continued, many of the highly migratory fish harvested were caught beyond 200 miles. It was argued that in the eastern Pacific, for example, over 35% of the harvests of major tuna species were taken beyond 200 miles (Joseph and Greenough 1979, p. 30).

Rather, these nations maintained, the highly migratory species should continue to be regarded as international common property and should be managed by international organisations (Burke 1984). What type of international organisation the USA, at least, had in mind was made evident by a draft Convention article on highly migratory species prepared by the American delegation. It stated:

> The highly migratory...resources...shall be regulated by appropriate international fishery organizations. Any coastal State party, or other State party whose flag vessels harvest or intend to harvest a regulated resource, shall have an equal right to particpate in such organizations (Revised Draft Articles on Fisheries Submitted by the U.S. to Sub-Committee II, 4 August 1972, G.A. Official Records (XXVII) Supp. 21 (1972) (A/8721), III Highly Migratory Oceanic Resources).

In essence, what the USA desired was an IATTC-type organisation in which distant water fishing nations would share, if not dominate, the management of the resources.

Not surprisingly, the developing coastal states at the Conference rejected this position. In their view, tuna, and other highly migratory species, were simply some among many transboundary resources. The Conference agreed that, while resident in the EEZ of a coastal state, a transboundary fishery resource was essentially the property of the coastal state. The coastal state should be prepared to cooperate with others in managing the resource, but this did not detract from the coastal state's property rights (U.N. Convention of the Law of the Sea, 1982, Article 63). What applied to other transboundary resources, the developing coastal states insisted, should apply with equal force to highly migratory species. The Pacific Islands were particularly explicit in their support of this view (Aikman 1987).

The outcome of the debate in the Conference was the inclusion in the Convention of an article, Article 64, directed specifically at highly migratory species. The article is seemingly contradictory. Paragraph 1 of the article maintains that, where no international organisations exist to manage such resources, the relevant coastal states should cooperate 'with other states whose nationals harvest these species,' i.e. including distant water fishing nations, to establish such organisations. Paragraph 2, however, states that Paragraph 1 of Article 64 is to 'apply in addition to the other provisions of this Part [V].'

The USA maintained that Article 64, paragraph 1, denied coastal state sovereignty over tuna and related resources and made it clear that the resources should be managed by truly international organisations (Burke 1984). Developing coastal states, e.g. the Pacific Islands, were equally insistent that Article 64, paragraph 2, clearly implied that Article 56 was to apply to highly migratory, as well as non-highly migratory, species, i.e. tuna resident in the EEZ of a coastal state constituted the property of that state (Swan 1988).

As the Conference drew to a close, most distant water fishing nations acquiesced, however reluctantly, to coastal state jurisdiction over tuna within the EEZs. The USA, however, clung to its position and embedded it in legislation (Van Dyke and Nichol 1987). The legislation went so far as to threaten any coastal state which impeded American vessels engaged in harvesting tuna. The punishments included, inter alia, an embargo on the importation into the U.S. of tuna and tuna products from the offending coastal state. The embargo could be extended to other fish products as well.

The American stand on highly migratory species was to lead it into conflict with several Pacific Latin American coastal states. This, in turn, was to lead to the undermining of the IATTC as a management body. It was, furthermore, to lead, inadvertently, to the establishment of links between the hitherto separate tuna fisheries of the eastern and western Pacific.

Impact of UNCLOS III

Other papers in this conference will devote themselves to a detailed discussion of the response of the Pacific Islands to the opportunities presented by Extended Fisheries Jurisdiction (EFJ), arising from UNCLOS III. No more than a brief summary is required here.

Meetings within the South Pacific Forum in mid 1976 gave birth to the concept that in time was to emerge as the South Pacific Forum Fisheries Agency (FFA) (Gubon 1987). The FFA was to coordinate the economic management of fisheries among the independent Pacific Island states, particularly with regard to tuna. The birth of the FFA proved to be not an easy one and the early years of the FFA were such as to lead several commentators, including me (Munro 1982), to view the future of fisheries cooperation within the Pacific Islands region with some pessimism.

The pessimism proved to be unfounded. The Pacific Islands, through the leadership of the FFA, have achieved a remarkable degree of cooperation in the economic management of fisheries (Munro 1988). The degree of cooperation achieved to date is far greater than that achieved in the eastern Pacific or in the ASEAN region. To what extent the cooperative achievement of the Pacific Islands reflects the fact that the Pacific Islands have very limited domestic tuna fleet capacity, and the fact that there existed no prior body in the region truly comparable to the IATTC, is a matter for speculation.

The response of the developing coastal states of the eastern Pacific to the opportunities promised by EFJ was much more complex. To date, the results have been far less satisfactory than those achieved in the Pacific Islands region.

With the advent of UNCLOS III, Pacific Latin American agitation for greater coastal state control over tuna resources increased. The Latins were not, however, united. Divisions emerged which still persist.

On the one hand, there were the member states of the Comision Permanente del Pacific Sur (CPPS — Permanent South Pacific Commission), founded at the time of the Santiago Declaration of 1952. These states — Chile, Peru and Ecuador (to be joined by Colombia in 1979) — were referred to as the territorialists and demanded, as we have seen, a territorial sea out to 200 miles. By implication, their claims to tuna within 200 miles were absolute.

We have also seen that such claims led to clashes between Ecuador plus Peru and the U.S. prior to UNCLOS III. Ecuador withdrew from the IATTC in 1968.

Whatever the EEZ is, it is not a territorial sea. The Law of the Sea Convention states explicitly that the territorial sea shall not extend beyond 12 nautical miles from shore (Articles 3, 4 and 5). The opposing group, led by Mexico and containing many of the Pacific Central American countries (the most prominent being Costa Rica), can be referred to as the EEZ group, indicating that the group accepted the Law of the Sea Convention as it stood.

Members of the EEZ group, which were also members of the IATTC, e.g. Costa Rica, began pressing for a reform of the IATTC by the mid 1970s. They demanded a reform which would reflect the impact of UNCLOS III and the emerging rights of coastal states (Szekely 1988). The first response to the pressure for reform was the drafting within

the IATTC of a plan referred to as the Partially Allocated Quota Plan (Joseph and Greenough 1979).

The plan, while making concessions to the Latin American members of the IATTC, nonetheless clearly reflected the American stance within UNCLOS III. The so-called Resource Adjacent Nations, e.g. Mexico, would be given preferential harvest allocations. This was in keeping with the U.S. support of the custodial/preferential approach to EFJ.

Most significantly, however, under the proposed plan, resource management control would be exercised through the IATTC. Thus, the management of the tuna would continue to be through an international organisation subject to distant water fishing nation (i.e. U.S.) influence.

The plan, and variants of it, were the object of several rounds of negotiations within the IATTC from the mid to late 1970s. For a time, it appeared that a partially allocated quota-type program would gain the acceptance of the lead members of the EEZ group, Mexico and Costa Rica.

Negotiations, however, ultimately broke down. Mexico left the IATTC in 1978; Costa Rica in 1979. Both countries began arresting unlicenced American tuna vessels within their 200 mile zones. Both countries found that their exports of tuna and tuna products to the U.S. were subject to embargo. One might add in passing that the U.S. had also imposed tuna embargoes on Ecuador and Peru.

In any event, the IATTC appeared to be in disarray and effective management of eastern Pacific tuna ceased. The Americans responded by attempting to salvage what they could. By 1983, they had persuaded Costa Rica, in spite of the earlier embargo, to enter into an interim agreement called the Eastern Pacific Ocean Tuna Fishing Agreement, and popularly referred to as the San Jose Agreement. Panama, Guatemala and Honduras have also signed. Similar to the IATTC convention, distant water nations would enjoy significant control over resource management under this scheme (Moore 1986). The Agreement has yet to receive a sufficient number of ratifications to come into force, and may never do so (Gomez 1987).

While the Agreement was yet to be ratified, it now appeared that there were three groups of Pacific Latin American tuna states. There were the territorialists as before, secondly an EEZ subgroup that would be prepared to contemplate, at least, an agreement leading to some degree of distant water nation management control, and finally an EEZ subgroup that was not prepared to contemplate such an agreement.

By the early 1980s, moves were taken to establish a coastal state-dominated cooperative mechanism to manage tuna. In 1981, the CPPS members agreed that measures had to be taken to cooperate in tuna management (Bustamente 1988). In 1983, there emerged under Mexican leadership, and through the relatively new organisation, the Organizacion Latinoamericana para del Desarrollo Pesquero (OLDEPESCA), negotiations for the establishment of an Eastern Pacific Tuna Organization (EPTO).

Only one country, Peru, is a member of both OLDEPESCA and the CPPS. Nonetheless, the two groups have come together to work towards the establishment of the EPTO.

Under the proposed EPTO convention, coastal state sovereignty over tuna within their EEZs or equivalent is unequivocal. Only the coastal states would have the power to issue fishing licences within the EEZs. The EPTO itself would issue licences for fishing tuna beyond 200 miles, but the EPTO, in contrast to the IATTC, would be dominated by the coastal states (Moore 1986).

Negotiations on the EPTO were still ongoing in early 1989. The gaps among the three groups have not been entirely eliminated. There has, moreover, been a further development, stimulated in part by the breakdown in the IATTC negotiations, which complicates EPTO negotiations.

In the mid 1970s, the Mexicans began the development of a tuna fleet. The development was, of course, spurred by the exclusion of the Americans from the Mexican zone at the turn of the decade. The Mexican fleet may currently have achieved the rank of largest tuna fleet in the world (Hudgins 1987). There are, moreover, reasons to suspect that Mexico has 'overshot the mark' in that, given the tuna resource availability off Mexico's shores, the Mexicans have excess capacity. There is further reason to believe that Mexico is on the verge of becoming a distant water tuna fishing nation. These, at any rate, are the inferences which I would draw from Gomez (1987).

The growth of the Mexican fleet impinges upon EPTO negotiations because the Mexicans take the position that only those distant water nations with a history of participating in the region should be granted access to EPTO member EEZs. South American tuna producers with little domestic capacity, e.g. Ecuador, want all distant water

nations, regardless of past history, to be able to compete for access rights (Guillermo Gomez Sanchez, Gomez-Hall Asociados, pers. comm.). The economic rationales underlying the two positions are too obvious to require stating.

With the breakdown in negotiations in the IATTC at the turn of the decade, the American tuna fleet found itself in a difficult position. Recall that in the early 1970s, even prior to the expansion of the Mexican fleet, there was clear evidence of excess capacity in the eastern Pacific tuna fleets. Now the U.S. fleet found itself unwelcome in the zones of the major resource-adjacent nations and in competition with a growing Mexican fleet in the fisheries beyond the Mexican zone.

The American fleet began searching for alternatives, in particular the western and central Pacific. In 1979, there were but three American tuna seiners operating in the western Pacific. By 1982, 20% of the American tuna fleet was operating exclusively in the western Pacific, while by 1986 the fleet was divided equally between the western and eastern Pacific. The American Tuna Boat Association conceded that an important reason (there were other reasons as well such as the El Nino phenomenon of 1982–83) for the shift had been the 'unsatisfactory' state of U.S.-Latin America tuna relations (Van Dyke and Nichol 1987, p. 116–117).

There was nothing, of course, to prevent individual American tuna vessels moving from the eastern to western Pacific and vice versa, in response to shifting conditions. It could, therefore, be argued that the tuna fisheries of the Pacific Islands region and those of the eastern Pacific were now linked, if not through the movement of fish, then by the movement of vessels.

The American tuna fleet coming into the western Pacific carried with it the American position on coastal state jurisdiction over tuna resources. The inevitable result was a series of clashes between the Americans and the Pacific Islands with the Americans using the embargo weapon they had employed against the Pacific Latin Americans. In the Pacific Islands, however, the Americans were confronting a group of coastal states which had achieved a high degree of unity and which had a uniform and unambiguous position on coastal state jurisdiction over tuna resources (Aikman 1987).

The clashes led eventually to negotiations and ultimately to the signing of the Treaty on Fisheries between the Governments of Certain Pacific Island States and the Government of the United States of America. What is of critical importance in this treaty is that the United States effectively concedes to the Pacific Islands property rights to tuna resources within their EEZs (Van Dyke and Nichol 1987).

While the United States has officially conceded such property rights only to the Pacific Islands, it is only a matter of time before the U.S. concedes, de facto if not de jure, such rights to other coastal states. It follows, in turn, that the Treaty must have a powerful impact upon the Pacific Latin Americans as they attempt to establish the EPTO, and, of course, as they negotiate with the United States and other distant water nations.

While the aforementioned developments were occurring in the Pacific Islands region and the eastern Pacific, important developments were also occurring in the ASEAN region. It will be recalled that, at the dawn of UNCLOS III, the role of ASEAN in Pacific tuna fisheries was minor. This was to change.

The potential for tuna harvesting in the ASEAN region lay primarily in the waters of Indonesia and the Philippines. The tuna fisheries of the two countries are linked biologically with those of the Pacific Islands, although the extent of the sharing of tuna resources is not fully understood.

In the early 1970s, the Philippines harvested no more than 10 000 t/annum. By the mid 1980s the annual harvest was in excess of 200 000 t. Indonesia has also enjoyed a rapid increase in production and is reported to have substantial unexploited potential in skipjack, yellowfin and bigeye resources (Ordonez 1988).

Philippine and Indonesian property rights to these resources have never been open to serious question. Both are archipelagic states. Such states have been given special rights to fisheries by the Law of the Sea Convention over the above Article 56 (these rights are set forth in Part IV, Archipelagic States, of the Convention).

While the expansion of tuna harvesting in the ASEAN region has been significant, what has been of greater importance is the growth of tuna processing in the region. This in turn is linked to an apparent shift in comparative advantage in tuna processing, particularly in canning, away from developed coastal states, such as the U.S. (Iversen 1987), to what might be termed middle level developing coastal states. We define such states to be those which have experienced significant growth, that are at a higher level of development than most

Pacific Islands, but which have yet to enter the ranks of the NICs.

The Philippines was the first ASEAN member to enjoy the benefits of this shift in comparative advantage, and began developing tuna processing capacity rapidly in the late 1970s. By 1982, it was the leading exporter of canned tuna to the dominant market for such products, the United States (Hizon 1986).

The Philippine processing sector has subsequently been impeded by many factors, the most important of which may be the short harvesting season in Philippine tuna fisheries and the overexploitation of the resource. The overexploitation evidences itself through the fact that a large proportion of the fish are small and hence not suitable for canning (Hizon 1986; Floyd and Doulman 1987).

The initial Philippine success was followed by that of Thailand, even though Thailand ranks far below the Philippines and Indonesia as a producer of tuna. Moreover, much of what the Thai fleet harvests is in secondary market species, not particularly suitable for processing for export. The Thai processing industry is thus heavily dependent upon imported raw material (Jaranthada 1988).

In spite of these limitations, Thailand has become the world's leading exporter of canned tuna. In 1975, Thailand's exports of canned seafood products of all species amounted to US $3.4 million. By 1985, the value of exports of canned tuna alone was approximately US $170 million (United Nations FAO, 1987), an amount which overshadowed Philippine exports of US $50 million for the same year.

By way of contrast, while tuna canning is present among the Pacific Islands members of the FFA, the amounts produced are relatively modest. In 1985, the total value of exports of canned tuna from the independent Pacific Islands was in the order of US $13 million (United Nations FAO, 1987). Indeed, a substantial portion of the tuna caught in the Pacific Islands region destined for the canned market is processed in Thai plants. There appears to be no precise estimate of the percentage of harvested Pacific Islands tuna that finds its way into Thai plants. Much of the tuna is routed indirectly. It has, however, been suggested to me by a senior Thai government official that it could be as high as 70%.

Post-UNCLOS III Pacific

The last decade and a half has led to radical changes in Pacific tropical tuna fisheries and industries. In the years immediately preceding UNCLOS III, Pacific tropical tuna resources were international common property. The fisheries based upon the resources were located in what were essentially two separate and distinct regions. The fisheries, and the industries centred upon them, were heavily dominated by developed distant water fishing nations — Japan in the western Pacific, and the United States in the eastern Pacific. Comparative advantage in both harvesting and processing lay with the developed countries, although admittedly there were signs that developed country comparative advantage in processing was beginning to fray.

Fifteen years after the formal commencement of UNCLOS III, the Pacific tropical tuna resources within 200 miles from shore have become, to all intents and purposes, coastal state property. There has, in addition, been an unmistakeable shift in comparative advantage in tuna processing away from developed coastal states to what we have chosen to call middle level developing coastal states. Finally, ASEAN has emerged as a third major region for Pacific tropical tuna fisheries.

The Pacific Islands fisheries now no longer constitute a separate and isolated entity, but rather are linked with the tropical tuna fisheries of both the eastern Pacific and ASEAN. The linkage with the eastern Pacific is through fleet movements. If Mexico becomes a distant water nation, these links could be strengthened.

The links with the ASEAN fisheries are primarily biological, i.e. the two regions share tuna stocks. If one talks in terms of industry, rather than just fisheries, then there are further linkages through the flow of raw tuna originating in the Pacific Islands region to Thai processing plants. Thai distant water fleets could in time provide further links between the two regions.

These developments of the past 15 years do not so much allow us to arrive at conclusions as to encourage us to pose two sets of questions which bear directly upon the future course of the Pacific Islands tuna industry. The sets are very much interrelated.

The first set of questions pertains to shifts in comparative advantage. I have yet to discover an adequate analysis of the reasons for the shifts in comparative advantage that have occurred in tuna processing. Without this knowledge, it is very difficult to predict future shifts in comparative advantage. Is the comparative advantage now held by middle level developing coastal states in

processing likely to be long term, or should we expect the comparative advantage to continue shifting within the near future to coastal states like the Pacific Islands?

If there is uncertainty about the shifts in comparative advantage in processing, there appears to be complete lack of knowledge about potential shifts in comparative advantage in harvesting. Does, for example, the growth of the Mexican fleet reflect a shift in comparative advantage, or was the expansion of the fleet artificially induced?

The second set of questions, which cannot be fully addressed until answers are obtained to those on comparative advantage, pertains to the degree of cooperation which should be developed between the Pacific Islands and their fellow producers of tropical tuna in the Pacific. The questions are basically the extent to which it is in the best interest of the Pacific Islands to encourage such cooperation, and secondly the forms which such cooperation should take, if in fact cooperation is desirable.

Some degree of cooperation with the ASEAN region for purposes of resource management is probably desirable. Such cooperation is in fact about to be explored through a new organisation called the Western Pacific Fisheries Consultative Committee (WPFCC), which has been established to foster Pacific Islands-ASEAN fisheries cooperation. There appears to be far less justification for such cooperation with the eastern Pacific.

If it is believed that the pattern of comparative advantage is such that the distant water fleets of the developed and newly industrialised coastal states will continue to dominate tropical tuna harvesting throughout the Pacific for the foreseeable future, then cooperation with both the ASEAN and the Latin American countries of the eastern Pacific may be desirable. The Pacific Islands have been successful in negotiating with such distant water nations by cooperating effectively with one another. The objective would be to enhance this success by extending the cooperation to fellow producers of tropical tuna in the Pacific.

Exploratory talks have in fact begun between the FFA and the CPPS plus OLDEPESCA. There are, in addition, indications that similar exploratory talks with the members of ASEAN may in time take place through the WPFCC. In fact, the Indonesian participants in the WPFCC have put forth for consideration a document containing an elaborate eight point program for possible Pacific Islands-ASEAN cooperation in tuna management. The proposals tend to go well beyond the management of the resource itself, to areas such as coordinated negotiations with distant water fishing nations and coordinated market strategy (Wisnumurti 1988). If one wished a plan of research on this issue of economic cooperation between the Pacific Islands and ASEAN in the area of tuna, one could do far worse than turn to the Indonesian document.

A recently held conference in Lima, Peru, for fisheries specialists from the Pacific Islands and Pacific Latin America, brought forth a similar document from Mexico (Gomez 1988). Like the earlier Indonesian document, it lays out a detailed set of proposals for economic cooperation between the two regions, in tuna matters. Once again this document could well serve as a plan of research on Pacific Islands-Pacific Latin America tuna cooperation.

One should also ask if there are any prospects for cooperation among the three Pacific regions on tuna matters. The answer I would give would be a decided yes, although much work remains to be done before it could become a reality.

Finally, if intra-Pacific cooperation among tropical tuna producers proves to be feasible and desirable from a Pacific Islands perspective, then it needs to be asked why such cooperation should be confined to the Pacific. Perhaps the Pacific Islands tuna industry would benefit through cooperation with tropical tuna producers outside of the Pacific, e.g. in the Indian Ocean.

Conclusions

The Third U.N. Conference on the Law of the Sea has had the effect of transforming the tropical tuna resources of the Pacific Islands region from international common property, the exploitation of which was dominated by developed distant water nations, e.g. Japan, into coastal state property. The development of the Pacific Islands tuna industry rests upon this fundamental fact.

This transformation did not, however, occur in isolation. In the two other major tropical tuna regions of the Pacific, the eastern Pacific and the ASEAN, similar developments occurred. Tropical tuna resources, which hitherto had been international common property, became developing coastal state property. These developments can be

expected to have an impact upon the progress of the Pacific Islands tuna industry.

ASEAN and Pacific Latin American tuna producers are obviously competitors of the Pacific Islands in the world tuna markets. Nonetheless, it is argued that the Pacific Islands may benefit economically through cooperation with these two other developing coastal state regions. Whether such cooperation is, in fact, desirable from a Pacific Islands perspective, and what forms this cooperation should take cannot be fully dealt with until a prior issue has been addressed. The prior issue concerns the nature and underlying causes of the shifts in comparative advantage occurring with tuna industries in the Pacific.

Acknowledgments

Funding for this paper was provided by the Social Sciences and Humanities Research Council of Canada and by the Donner Canadian Foundation through a grant to the Institute of International Relations research project on 'Canada and International Regulatory Management Regimes' at the University of British Columbia.

References

Aikman, C.C. 1987. Island Nations of the South Pacific and Jurisdiction Over Highly Migratory Species. Victoria University of Wellington Law Review, 17, 101-124.

Barrett, I. 1980. Development of a Management Regime for the Eastern Pacific Tuna Fishery. Unpublished PhD Dissertation, University of Washington, Seattle.

Burke, W. 1984. Highly Migratory Species in the New Law of the Sea. Ocean Development and International Law Journal, 14, 303-310.

Bustamente, T. 1988. Draft Agreement Creating the Eastern Pacific Tuna Organization and Its Background. Paper prepared for the Pacific Latin America — Pacific Island Nations International Fisheries Conference, Lima.

Floyd, J.M., and Doulman, D.J. 1987. The Development of the Philippine Tuna Industry. In David J. Doulman (ed.), The Development of the Tuna Industry in the Pacific Islands Region: An Analysis of Options. Honolulu, East-West Center, 169-186.

Gomez, G. 1987. Mexico: A New Dimension in the Western Pacific Tuna Fishery. Paper prepared for the Workshop of the Pacific Economic Cooperation Conference Task Force on Fisheries Development and Cooperation, Manila.

1988. Tuna Linkages and Areas for Cooperation in Tuna Management and Development between Latin American Coastal States and Island Nations of the Pacific. Paper prepared for the Pacific Latin America — Pacific Island Nations International Fisheries Conference, Lima.

Gubon, F. 1987. History and Role of the Forum Fisheries Agency. In David J. Doulman (ed.), Tuna Issues and Perspectives in the Pacific Islands Region, Honolulu, East-West Center, 245-256.

Hizon, V.R. 1986. The Philippine Tuna Experience. Paper prepared for the Institute for Marine Studies, University of Washington, Tuna Workshop, Vancouver.

Hudgins, L.L. 1987. The Development of the Mexican Tuna Industry. In David J. Doulman (ed.), The Development of the Tuna Industry in the Pacific Islands Region. Honolulu, East-West Center, 153-168.

Iversen, R.T.B. 1987. U.S. Tuna Processors. In David J. Doulman (ed.), The Development of the Tuna Industry in the Pacific Islands Region. Honolulu, East-West Center, 271-288.

Jaranthada, K. 1988. The Tuna Industry and the ASEAN Region. In Elvira Baluyut (ed.), Summary Report and Papers Presented at the ASEAN — Pacific Island Nations International Fisheries Conference, Manila, Philippine PEC Committee, 60-79.

Joseph, J., and Greenough, J.W. 1979. International Management of Tuna, Porpoise and Billfish. Seattle, University of Washington Press.

McRae, D., and Munro, G. 1988. Coastal State 'Rights' Within the 200-Mile Exclusive Economic Zone. Paper prepared for the Workshop on the Scientific Foundations of Rights Based Fishing, Reykjavik.

Moore, G. 1986. Current Trends in National and International Arrangements Regarding Tuna Management and Development. Paper prepared for the Institute for Marine Studies, University of Washington, Tuna Workshop, Vancouver.

Munro, G.R. 1982. Cooperative Fisheries Arrangements between Pacific Coastal States and Distant Water Nations. In H.E. English and Anthony Scott (ed.), Renewable Resources in the Pacific, Ottawa, International Development Research Centre.

1988. International Cooperation for Resource Management: Fisheries. University of British Columbia, Department of Economics Discussion Paper No. 88-08.

Ordonez, J.A. 1988. Problems of Tuna Management in the ASEAN. In Elvira Baluyut (ed.), Summary Report and Papers Presented at the ASEAN-Pacific Island Nations International Fisheries Conference, Manila, Philippine PEC Committee, 99-106.

Saila, S.B., and Norton, V.J. 1974. Tuna: Status, Trends and Alternative Management Arrangements. Washington, Resources for the Future.

Swan, J. 1988. Tuna Management in the South Pacific. In Thomas A. Clingan, Jr. (ed.), The Law of the Sea: What Lies Ahead?, Honolulu, Law of the Sea Institute, 177-183.

Szekely, A. 1988. Tuna in the Eastern Tropical Pacific. In Thomas A. Clingan, Jr. (ed.), The Law of the Sea: What Lies Ahead?, Honolulu, Law of the Sea Institute, 177-183.

United Nations. 1982. Convention on the Law of the Sea.

United Nations, FAO. 1987. Yearbook of Fisheries Statistics 1985, Vol. 60, Rome.

United States EEZ Proclamation and Ocean Policy Statement of March 10, 1983. Weekly Compilation of Presidential Documents 384 (1983).

United States, Revised Draft Articles on Fisheries Submitted by the U.S. to Sub-Committee II, 4 August 1972, G.A. Official Records (XXVII), Supp. 21 (1972), (A/8721).

Van Dyke, J.M., and Nichol, C. 1987. U.S. Tuna Policy: A Reluctant Acceptance of the International Norm. In David J. Doulman (ed.), Tuna Issues and Perspectives in the Pacific Islands Region. Honolulu, East-West Center, 105–132.

Wisnumurti, N. 1988. Scope for ASEAN-Pacific Island Nations Consultations/Cooperation on Tuna Management/Joint Ventures. In Elvira Baluyut (ed.), Summary Report and Papers Presented at the ASEAN — Pacific Island Nations International Fisheries Conference, Manila, Philippine PEC Committee, 113–121.

A Critical Review of Some Aspects of Fisheries Joint Ventures

David J. Doulman[1]

Abstract

Joint ventures are often considered to be the most appropriate means of promoting industrial fisheries development in the South Pacific. However, the performance of these ventures, from the point of view of governments in the region, is in most cases below expectations. They are likely to pose particular difficulties for governments to effectively monitor and control, and so the benefits flowing from these ventures will be less than they might otherwise have been. Alternative arrangements for the establishment of fisheries joint ventures in the South Pacific are proposed for investigation.

Introduction

FISHERIES joint ventures are often hailed as the most appropriate means for countries to promote resource development. There is an extensive literature on the subject and since the 1960s a plethora of fisheries sector studies has been commissioned by international, regional and national organisations to determine the extent of joint venture arrangements around the world, their characteristics and the nature of their operations, in a bid to assess the benefits they provide both for the host country and for the foreign or domestic partners participating in the ventures. In contrast, alternative avenues for promoting industrial development, such as wholly government-owned corporations, statutory bodies or private sector investment have not attracted such international scrutiny. Explicitly or implicitly, the assumption has prevailed that sustained industrial development would flow naturally from the establishment of joint ventures and that there would be an equitable sharing of benefits based on the equity positions of, or the financial commitments made by, the partners participating in the ventures.

The European Community's Centre for Industrial Development describes joint ventures as 'An efficient and equitable way of transferring technology and investment capital' (Centre for Industrial Development 1983). Under ideal circumstances this rationale for the establishment of joint ventures can be substantiated but, in the cold, real world of commercial enterprise, other important considerations come into play. While joint venture arrangements can promote technology and capital transfer, the distribution of benefits from fisheries ventures and their operational profitability have led industry commentators, politicians and bureaucrats in developing countries to question seriously the returns that they might reasonably expect to receive. In conventionally structured fisheries joint ventures, the projected outcomes of the ventures rarely match the results in practice.

[1] The author is Deputy Director of the Solomon Islands-based South Pacific Forum Fisheries Agency, PO Box 629, Honiara. The views expressed in this paper are his own and do not necessarily represent the views of the Agency nor those of any of its member countries. The author is indebted to W.S. Pintz, resource consultant, Honolulu, who contributed very useful comments on the paper. However, the usual disclaimer applies. The author alone is responsible for any of its shortcomings.

Taking the position of a prospective government investor, this paper critically, provocatively and generally reviews important elements of joint venture arrangements. It is largely based on my experience with attempts to establish joint ventures in the South Pacific region, on experience as a government-appointed board member of one such venture, and on research related to the operation of fisheries joint ventures in the region. The paper does not purport to provide an in-depth theoretical or comprehensive treatment of joint ventures, but rather to present a set of observations that might be of value to countries contemplating the establishment of such ventures. Moreover, the paper does not focus on particular fisheries joint ventures in the South Pacific, though there are several ventures that could be used to illustrate points made in the paper.

After this introduction, joint ventures are defined and their objectives discussed. The selection of joint venture partners is then examined, followed by a review of equity participation for both government and the foreign partner. In the next section the terms and conditions of joint venture agreements are evaluated and aspects of monitoring ventures, after they are operational, considered. On a positive note, potential alternative arrangements to conventional fisheries joint venture arrangements are presented. The paper concludes that conventional fisheries joint ventures are unlikely to be the most satisfactory and financially rewarding means of developing industrial-scale fisheries and that fertile ground exists for objective academic research to determine the appropriateness of alternative approaches.

Definitions

What is a Joint Venture?

A commonly accepted definition of a fisheries joint venture is the definition used by Kaczynski et al. (1984) in which a joint venture is '. . . an association of two or more partners who share risks and benefits of a joint commercial, or in some cases, non-profit use and development of marine living resources.' This is an all-embracing definition, but in the context of this paper only industrial-scale commercial ventures that are legal arrangements between private foreign investors and governments are considered. Joint venture arrangements between foreign investors and/or domestic investors are not discussed.

Fisheries joint ventures can be contractually structured in a number of different ways, though equity joint ventures are the most common in the South Pacific region. These are ventures where all partners take up an equity shareholding, and in so doing commit funds to the venture and assume other financial obligations such as raising and underwriting loan and operating capital. In turn, profits from the venture are distributed on the basis of equity holdings of the partners.

When joint venture agreements are being negotiated, the foreign partner usually favours equity ventures. This is done for several reasons, the most important of which is to limit financial exposure, to be able to raise capital more easily on international markets because of the government's shareholding, and to have the security and comfort of government protection after the venture is operational.

Objectives

Joint ventures are established for the mutual benefit of the partners, though the objectives of government and the foreign partner are unlikely to be congruent. It is this incongruency in outlook that promotes friction after the venture is operational. Difficulties can stem from a variety of sources, ranging from corporate policy on reinvestment and distribution of profits, marketing and management arrangements, alleged and actual transfer pricing practices, to charges that government is failing to extend sufficiently favourable concessions to the venture.

When entering into a fisheries joint venture the government will usually provide some or all of the following inputs and concessions to the venture: preferential or exclusive resource access, land for shore-based development, infrastructure, fiscal incentives, assurances of government approvals for activities associated with the venture, equity and operating capital, and a willingness to underwrite loans. The foreign partner, on the other hand, will be normally required to contribute capital, loan guarantees, technology, market expertise, training and management. The contributions of the government and the foreign partner should be complementary.

In fisheries joint ventures the government will always have broader, longer-term concerns than the foreign partner whose principal interest is to maximise its financial return, either through legitimate or other means, and to maintain its

position in the industry and its resource base within the country. While government will certainly focus on the need for the venture to be commercially successful, it will also be vitally concerned with its impact on the national and regional economies, structural distortions that the venture might promote, social effects as well as the effect that the venture might be expected to have on public revenue. Government concern for income distribution effects of the venture is also likely to be important in a number of countries in the South Pacific region.

The need for government to exercise control over industry is sometimes cited as the primary motivating factor for it entering into a fisheries joint venture. If the primary objective of government is industry regulation and the desire or need to maximise financial returns to the country from that industry, simpler and more effective means of achieving these goals exist. If industry regulation and the generation of revenue are priorities, a more cost-efficient approach is for government to utilise fiscal and other measures that it has at its disposal.

With a narrower and a shorter-term perspective, the motivation of the foreign partner to enter into and to remain in a fisheries joint venture is often not to contribute to the development of the country's industry per se, but to secure raw material as a throughput for a processing plant owned by the parent or an affiliated company overseas, or to obtain product for marketing through its parent's established international network. As a general rule, the harvesting phase of the fishing industry is the high-risk, marginal return end while the marketing of unprocessed or processed fish, once trade links and outlets are established, tends to be less risky and more financially robust. For this reason the foreign partner will normally seek exclusive marketing rights for all of the venture's products.

Despite the differences in orientation between the government and the foreign partner in a fisheries joint venture, a reasonable degree of compatibility, harmony and mutual trust must exist if the venture is to be successful. Where these conditions are not met the venture will be handicapped and its chances of commercial success reduced.

Selection of Partners

The selection of joint venture partners is a critical decision for government. It is not possible to lay down universal guidelines for the selection of partners, except to specify that partners should have demonstrated financial, operational and marketing capabilities in the fisheries field. Joint venture failure is sometimes due to the foreign partner having been poorly selected. Where political decisions are made to cooperate with a foreign partner, considerations other than the competence of the partner might affect selection. Government to government introductions and recommendation of partners can also lead to the selection of inappropriate joint venture partners.

Despite obstacles in the selection process, the government should seek verification of the background and industry reputation of all potential foreign partners. Checks can be instituted privately (e.g. through commercial accounting firms) or through the United Nations Centre on Transnational Corporations, which provides a corporate investigation service free of charge. For internationally known companies the corporate check is not so important, but for potential partners that are lesser known, an initial credit check will usually determine whether a potential partner should be considered seriously.

Joint ventures that have a consortium of foreign partners have considerable advantages over those that only have one partner. The consortia approach to the establishment of fisheries joint ventures in the South Pacific region has been common. However, before entering into an agreement with a consortium, the government should determine that its partners have complementary interests that are in the overall interest of the venture. Complementary interests will strengthen the venture by increasing the range of skills, expertise and contacts available to it; by having the foreign partners keep a check on each other, thereby helping to keep the partners 'honest' and, depending on the structure of the venture, by reducing the financial exposure for each of the partners and for government.

In selecting joint venture partners governments should avoid partners (many of whom are large multinationals) that have other fisheries ventures that would be competitors for the venture being established. This is because when market conditions are tight the foreign partner might not support the venture completely owing to conflict of interest vis-a-vis its other ventures. There has been at least one instance of this situation arising in the South Pacific, although it did not involve a joint venture.

Equity Considerations

In negotiating the establishment of a joint venture the foreign partner will want the government to maximise its financial exposure while forgoing a controlling interest in the venture. The foreign partner also recognises that significant government participation enhances the 'respectability' of a venture, and on international capital markets it should be easier to raise investment funds. The task of fund raising will be facilitated if the government is willing to underwrite loans. With substantial government involvement, the financial and industry reputation of the foreign partner will be of lesser importance.

As an initial negotiating position, the foreign partner will normally request the government to take up a 49% equity share in a venture. The rationale for this position is that the government will have approximately the same financial exposure as the foreign partner, but that the foreign partner will maintain control by virtue of its 51% holding. Foreign partners might argue that it is advisable for the government to assume a 49% shareholding so as to exercise control over the country's fishing industry. However, in proposing such a shareholding the foreign partner is primarily concerned about its own financial exposure rather than orderly development and management of the industry.

To minimise financial exposure, governments should consider taking up a maximum of 20% equity in joint ventures. While achieving this goal, they would still maintain a significant presence in the venture. If the venture is dependent on the government having a higher equity stake, and if it is willing to increase its exposure, the government should opt for an equity holding of 51% or more. In this way its financial exposure and its control of the venture will be commensurate.

Equity positions within a joint venture are subject to negotiation prior to the execution of the venture's agreement, usually after the feasibility study is completed and the commercial viability of the venture is demonstrated. In joint venture agreements the government should insist on a provision to increase its equity holding after the venture is established, or to dispose of its holding should it so desire or to transfer its holding to provincial authorities or land owners where the venture is located. In practice, the option for government to increase its shareholding in a venture will assist in ensuring that the venture operations remain consistent with government policy and directions. It might not always be possible to achieve this compliance through the venture's board of directors, particularly if the government has a minority equity position. The possibility of increasing the government's equity holding will usually be sufficient to elicit a high degree of voluntary compliance by the venture, but only in exceptional circumstances would it be necessary for government to invoke this provision.

In some cases governments might regard the establishment of a joint venture as a transitional form of investment for developing the country's fisheries resources, and public participation in the venture might be justified on these grounds. In reality, however, the venture is likely to remain a joint venture unless the foreign partner opts to terminate its association with it. It is difficult to find examples where governments have withdrawn from joint ventures. The usual case is for the foreign partner to withdraw and for the government to find that it is in possession of a wholly owned fisheries corporation.

If joint ventures are financed on a 'turn-key' basis utilising export credits from the foreign partner's government, and if competitive tendering is not required, the willingness of the host government to underwrite a venture will be usually sufficient to satisfy conditions for the supply of export credits.

Foreign partners will also seek government participation in joint ventures for security and comfort purposes. This will be particularly the case for partners that are new to the South Pacific region or that have experienced difficulties with investments in other parts of the world. Government participation in a venture can be used also by the foreign partner to justify preferential treatment and a range of other concessions. The foreign partner reasons that with public involvement in a venture and with government support, the venture will be more secure against downstream challenges by resource owners and other interest groups.

Agreements

For government, the successful operation of a fisheries joint venture will be closely allied with two important sets of considerations: 1) the provisions of domestic legislation and the agreements upon which the ventures are based, and 2) the willingness and the ability of the government to monitor and

enforce its legislation and the terms of the joint venture agreements. Aspects of fisheries and industrial development legislation are not discussed in this paper, but monitoring and enforcement of agreements are examined in the next section.

Joint venture agreements should be comprehensive, internally consistent and precise so as to minimise scope for interpretation. A carefully drafted agreement should facilitate the speedy resolution of disputes. Loosely drafted agreements will give rise to differences in interpretation of rights and obligations after ventures are established and this will affect their operation, possibly necessitating further negotiation. In the extreme these differences could lead to the termination of an agreement.

Head Agreement

Joint venture undertakings are most appropriately structured with a head, master or umbrella agreement and a number of subsidiary agreements. Among other matters, the head agreement will specify the objectives of the venture, the general parameters governing its operations and the broad rights and obligations of the partners.

When a joint venture is being considered, the foreign partner will often present the government with a fully drafted head agreement for the venture. The foreign partner will argue that the draft should be accepted as a means of getting the venture operational with minimal delay. Invariably the agreement is poorly drafted, wide open for interpretation, affording maximum benefit for the foreign partner and little protection for government. The foreign partner might also maintain that the conclusion of subsidiary agreements is unnecessary because they will complicate the operation of the venture. As a matter of principle, and as a means of ensuring that it retains the position of advantage in negotiations, the government should insist always that negotiations proceed on the basis of the agreement provided by the government.

Subsidiary Agreements

The subsidiary agreements contain the specific details relating to the establishment and operation of the joint venture. The use of subsidiary agreements reduces the complexity of the head agreement and should facilitate a more precise delineation of the venture's terms and conditions. As a minimum, separate subsidiary agreements should be concluded in respect of the joint venture's shareholding and transfer of shares, financing provisions, purchase of provisions and supplies, management, marketing, and training and localisation.

Of critical importance is the need to ensure that the purchase, management and marketing agreements are premised on 'arm's length' principles. This is to try to ensure that scope for transfer pricing and related financial practices is minimised. In the absence of tight and enforceable subsidiary agreements, joint ventures are 'milked' through inadequate supply, management and marketing. While a venture's financial viability is inhibited by these practices, the parent or associated companies of the foreign partner benefit at the expense of the venture and the government through the loss of investment income and taxation revenue.

The purchase agreement The secondary benefits associated with a fisheries joint venture will normally be as great as, or greater than, the primary benefits generated by the venture. To try to ensure that secondary benefits are maximised and that the venture is not unnecessarily burdened with expensive imported goods, it is necessary to conclude a subsidiary purchase agreement. Without a purchase agreement, it is likely that a company owned by, or associated with, the foreign partner will be contracted to supply the venture with products on a noncompetitive basis. Under these circumstances supplies are unlikely to be purchased from the cheapest source. Goods supplied to the venture at inflated prices (the inflation being justified on the grounds of overhead costs of the associated company) erodes the venture's financial position.

The management agreement Efficient and cost-effective management of a joint venture is crucial to its success. Because South Pacific countries are generally lacking in managerial expertise for industrial-scale fisheries undertakings, it is conventionally argued that joint ventures will assist in overcoming the shortage of skilled personnel. However, what is not so commonly considered is the inherent conflict of interest that arises with the operation of the venture if the foreign partner is given unbridled access to its management. Often joint venture management agreements are weak and there are few real limitations placed on the foreign partner. Under these circumstances scope to manipulate management costs is unconstrained, with the result that it is easily possible to deprive the venture of legitimate revenue.

The marketing agreement A forceful and persuasive argument used by foreign partners to rationalise the establishment of joint ventures is the acquisition of specialised marketing skills. The myth has been perpetuated in the South Pacific region that in order to successfully market fish on the world market the involvement of a corporation with multinational links was necessary. This myth was perpetuated in order to permit the foreign partner in joint ventures to gain sole marketing rights to unprocessed and processed fish from the venture. The assignment of these rights enabled the foreign partner to transfer price, especially when the product was on-sold to an associate company. It also created an unwarranted dependency on the foreign partner for the sale of the venture's fish.

The withdrawal of foreign partners from ventures in the South Pacific or the adoption of a more independent approach by governments with respect to fish marketing has demonstrated that there is no magic to the international marketing of fisheries products, especially those that are in short supply such as prawns and good quality canned tuna. While quality and quantity must be maintained if international markets are to be penetrated and market shares retained, it is possible for South Pacific countries to effectively market fisheries products from industrial-scale ventures and to achieve excellent returns. Where foreign partners have withdrawn from joint ventures in the region or where a more aggressive and independent marketing approach has been forced by government, market returns have increased significantly.

The marketing agreement needs careful and precise negotiation and must be based on a thorough understanding of the international market for the fish products being harvested and processed by the venture. This information is necessary in order to demystify the marketing arguments that will be put forward by the foreign partner to have an exclusive marketing agreement, giving it considerable latitude and few checks. It is important that the agreement specify floor prices and the announcement of export prices prior to shipments being made. Options to purchase by a third party at announced prices should also be provided for in order to prevent product being exported at below reigning world market prices. Other checks can also be instituted to ensure that fair returns are being received, such as a requirement that the venture's product is directed to the most favourable international market.

Need for Specialist Input

The negotiation of the head and subsidiary agreements for fisheries joint ventures requires specialist input from those connected with the fishing industry. While some of this expertise will be available within the government, it might be necessary to engage consultants to assist with joint venture negotiations and the finalisation of agreements. Management and marketing agreements, for example, should be concluded only after the corporate structure of the foreign partner is well understood and the international market for the fishery's products known. The role of the foreign partner in the market should also be investigated. Too often research of this nature is overlooked and the drawing-up of joint venture agreements is seen primarily as an exercise in legal drafting. While the legal aspects of the agreements are critical, the content of the agreements should reflect the realities of the fishery, the marketplace and the foreign partner's international operations.

Monitoring and Enforcement

Joint venture agreements take considerable time and much effort to negotiate and, after the venture is established and government directors have been appointed, there is a tendency for the government to relax and to wait for the benefits of the venture to start flowing. However, it is at this point that governments should institute vigilant procedures to ensure that the venture is managed and operated in accordance with national laws and the terms and conditions of the joint venture agreement.

Monitoring

Government monitoring of joint ventures takes place primarily at two levels. There is the general and ongoing monitoring that is routine for all companies operating in a country. Some of this information is confidential (e.g. income tax returns) while other information is publicly available (e.g. annual returns to the corporate registrar). Information submitted by corporations through these statutory channels can be used to monitor the performance of a joint venture, but it is of little practical value in trying to provide direction to, and control over, a venture because this information is historical.

As a shareholder in a fisheries joint venture, government can affect policies relating to its

operations through its representatives on the venture's board of directors. It is at this second level that effective monitoring and the provision of direction should take place. However, the performance of government-appointed directors on the boards of joint ventures can be disappointing because their civil service backgrounds do not equip them well to assume an active role in the commercial world.

Government direction of joint ventures is frequently hampered by basic constraints such as directors being unable to read balance sheets and statements of profit and loss; by directors being unfamiliar with the duties and responsibilities of corporate board members; by directors having little understanding of company law, and in some cases limited knowledge of the fishing industry or of the foreign partner. Usually government directors are appointed to a joint venture board on the basis of their civil service positions, and not because they possess the necessary skills to effectively perform directors' functions.

The situation therefore arises, and can exist for an extended period of time, where the government has a significant shareholding in a joint venture but is not able to provide effective direction at the board level because of inexperienced public sector appointees. This enables the joint venture partner to exercise influence in company policy and operational matters in the absence of proper consideration and scrutiny by the government.

A possible solution to the problem relating to inexperienced government board members is to hire private law and accounting firms to assist members in the execution of their corporate responsibilities. While hiring these firms will not be cheap, and might be opposed by some government ministries, it might ensure that government interests in joint ventures are reasonably protected. Training for corporate directors from the public sector has been undertaken in at least one country in the South Pacific region in an effort to develop better skilled directors. This might be a longer-term solution.

Enforcement

For strictly political or other reasons, government might be unwilling to enforce rigidly the terms and conditions of a joint venture agreement. The reasons for the government taking this position are complex and highly sensitive. However, unless the government is prepared to insist on the strict adherence to the terms of the agreement, it will forgo benefits that it should rightfully receive. If a fisheries joint venture has a prominent position within the economy, government might be reluctant to fully enforce the agreement because of economic repercussions that might be encountered if the venture's operations are disturbed.

Casting a Wider Net on Joint Ventures

In considering the appropriateness of conventionally structured fisheries joint ventures, it is worthwhile exploring alternative foreign investment vehicles used in other resource sectors. For illustrative purposes, four alternative investment approaches serve to summarise the foreign investment spectrum. These alternatives are: 1) conventional regulatory/fiscal systems with no direct government equity participation; 2) a variation on the production sharing agreement common in the oil industry; 3) a special joint venture arrangement called a 'fade-out' agreement, and 4) a joint venture variant where the government has certain conversion rights for transferring fiscal measures (such as export taxes) into equity or vice versa.

Although the last three specialised arrangements have not been used in foreign fishing arrangements in the South Pacific region, there might be circumstances where they are appropriate. Furthermore, it is possible that the conventional regulation approach (e.g. without the financial exposure and risk associated with ownership) might deserve a fresh look by objective analysts. Indeed, several South Pacific countries are reconsidering the equity involvement issue in their arrangements with mining and petroleum investors.

Although clearly a retreat for direct industry involvement and the political attractiveness of ownership, a conventional regulatory approach to foreign investment in the fisheries sector might be one channel for simplifying government objectives with respect to the development and management of the industry. It is well known that there are inherent conflicts between government promotion, regulation, taxation and shareholding roles. In a joint venture undertaking, the balance between these roles is inherently uncertain and sometimes irrational. With conventional arrangements, one

major ambiguity (i.e. the shareholding role) is eliminated.

In oil ventures, production sharing arrangements are common. At the risk of belabouring the conceptual nuances of oil production sharing, one interesting feature is the expression of ownership in a physical sharing of production. To protect its interest in the early days of a new venture, a developing country might negotiate an arrangement where the foreign partner is required to market the government's share, if requested to do so. Conversely, if the government has the confidence, it might assume a direct marketing role and thereby develop an independent measure of its foreign partner's efficiency or of its propensity to transfer price.

In a 'fade-out' agreement the foreign partner moves towards transfer of majority ownership in a series of contractual specified milestones which are designed to minimise entrepreneurial risks for government (e.g. significant ownership transfers might occur at 'investment recovery' or 'debt retirement').

Finally, an equity conversion scheme might focus on providing the government with early revenues from the project (e.g. perhaps through an export tax) while reserving an option for eventual equity, at a contractually specified rate, in the future. For example, a recent South Pacific mining agreement sets the conversion rate of export tax to equity shareholding at the rate of 1% export tax equal to 5% equity ownership. Such a conversion option is primarily a fiscal strategy and has significant implications for the assumption of entrepreneurial risk for government.

The above approaches are suggested merely to illustrate alternatives to the conventional joint venture approach. Each of the suggested alternatives has distinct advantages and potential disadvantages that need careful objective assessment. Such assessment might be a fruitful area for research and academic enquiry.

Conclusion

Arguments for the establishment of conventional fisheries joint ventures are premised on government being able to effectively participate in the direction of the venture. Technology and capital will be transferred and the government will derive benefits from the venture proportional to its shareholding provided that it can effectively provide that direction and that it is prepared to do so. Unfortunately, because foreign partners regard governments in the South Pacific as 'fair game' in fisheries joint ventures, they rarely return a profit. It is only when the foreign partner withdraws and independent management is hired to replace the former management that the ventures start to operate profitably.

The reasons for the poor performance of conventional fisheries joint ventures in the South Pacific are varied, but they are due partly to inexperienced government-appointed directors, loosely drafted agreements, political intervention, and a lack of understanding of overseas industry connections of the foreign partner.

While conventional joint venture arrangements are one avenue for developing industrial-scale fisheries, other options exist. These options should be evaluated to determine whether they are appropriate to the needs of countries in the South Pacific, whether they are appropriate for the fisheries sector, and whether they are politically acceptable. Sensitive and objective academic enquiry could assist South Pacific countries determine novel approaches to structuring and promoting foreign investment in the fisheries sector in the region.

References

Centre for Industrial Development. 1983. Joint ventures. The Courier, No.79, 53–56.

Kaczynski, V.M., Klein, A., and Hasegawa, F. 1984. Foreign investment in international fishery ventures in the Asia/Pacific. Infofish Marketing Digest, No.3, 13–16.

The Tuna Resource Base in the Pacific

Bob Kearney[1]

Abstract

There is no doubt tuna constitute the major fisheries resource of the Pacific Islands region. Consequently the economics of fisheries management in this region are dominated by developments in tuna fisheries. Considering the geography and oceanography of the region it is unlikely this will change in the forseeable future. In addressing the tuna resource base in the Pacific, I have made two assumptions: firstly, the resource base includes not only the total biomass of fish but also the factors which influence the exploitation (harvesting) and onservation of the fish stocks in question; and secondly, while the resources of the total Pacific are of interest to this group, discussion should be concentrated on the resources of the Pacific Islands region.

Tuna Species, Exploitation Levels and the Total Resource

FROM previous experience with presenting information and opinions on Pacific tuna resources and fisheries, I have found it easiest to divide the subject on a species basis; I see no reason to break from tradition.

Although 10 species of tuna occur in the tropical central and western Pacific, four species account for almost the entire commercial catch. These four species are skipjack (*Katsuwonus pelamis*), yellowfin (*Thunnus albacares*), albacore (*Thunnus alalunga*), and bigeye (*Thunnus obesus*).

Skipjack

The domination of world tuna landings by skipjack has increased in recent years with this one species accounting for more than 47% of world tuna landings in 1986 (Table 1). In the Pacific Islands region this dominance is even greater at 56%. The great majority of skipjack catches throughout the world are taken by purse-seining but in the Pacific Islands region pole and line fishing remains of great importance, particularly to Solomon Islands and Fiji.

Table 1. World, total Pacific Ocean and South Pacific catches of major tuna species in 1976 and 1986. (All figures in 000s metric tonnes.)

	World total		Pacific total		SPC area	
Species	1976	1986	1976	1986	1976	1987[a]
Skipjack	666	1084	554	816	259	353
Yellowfin	558	774	417	524	104	210
Albacore	232	180	158	84	15	6
Bigeye	185	248	142	147	36	62
Total	1641	2286	1271	1571	414	631

[a]1986 figures not available.

Much of the scientific information on skipjack has been generated by the South Pacific Commission (SPC). The Commission's work has demonstrated that individuals of this species vary

[1] Fisheries Research Institute, NSW Agriculture and Fisheries, PO Box 21, Cronulla NSW 2230 Australia.

greatly in mobility. Some individuals travel thousands of miles in their short life span while others remain associated with a particular area for lengthy periods. The magnitude of the total skipjack resource in the SPC area has been estimated to be of the order of 3 million t. The extremely high natural mortality of this highly opportunistic, cannibalistic predator, coupled with frequent and prolific reproduction, is indicative of a resource capable of sustaining tremendous catches. It has been suggested that catches of the order of 2–3 million t/annum could be taken. As this represents approximately six times present catch levels, the future of the total resource seems secure.

Yellowfin

Yellowfin tuna are exploited commercially by a variety of gears with purse-seining accounting for the greatest catches but longlines and handlines producing fish of much higher unit value. Like skipjack, yellowfin are predominantly tropical and highly mobile but their life span is longer and maximum size much greater. This longer life and associated lower natural mortality renders them more vulnerable than skipjack to extreme fishing pressure. Preliminary estimates by SPC scientists suggest a resource base of the order of 600 000 t in the Pacific Islands region, which, if correct, would suggest that the present levels of exploitation are approaching the maximum possible.

Albacore

Albacore do not normally occur in surface schools in the tropical Pacific and consequently they have been exploited almost exclusively by longlining. Declining relative world prices for albacore in the late 1970s and 1980s resulted in a significant decline in the total Pacific longline catches of this species. However, in the last few years, the development of surface fisheries by trolling and gillnetting south of the Pacific Islands region greatly increased landings of this species from the South Pacific.

Bigeye

This species does not normally occur as surface schools in tropical waters and has traditionally been exploited by longlining. In recent years as deeper purse-seine nets grow in popularity and nighttime fishing techniques are developed, this species is becoming increasingly vulnerable. Bigeye tuna have traditionally been considered as an underexploited resource but this confidence is based largely on a lack of trends in catch per unit of effort for what is most often a nontarget species. Little confidence can be placed in such assertions and considering the magnitude of the landings of bigeye tuna throughout the world, remarkably little is known about the nature of the resource.

Billfish

Several species of billfish are taken throughout the tropical Pacific with the most important being blue marlin (*Makaira nigricans*), black marlin (*Makaira indica*), and striped marlin (*Tetrapturus audax*). With the exception of the recreational gamefish fisheries marlin are taken as a bycatch in other tuna fisheries. The magnitude of the resource of each species is not well defined, however it is generally acknowledged that most species are at least moderately heavily exploited and that there is very limited potential for increased exploitation except as a basis for gamefish fisheries.

Fisheries Management; Importance of the Resource Base

In any discussion of fisheries management it is wise to first define what one means by management. My interpretation of the word is broad. I assume that management includes development as one of its options. I also include in management all of the decision-making processes which affect the fishery, right from the individual fishermen deciding whether or not to buy a boat, through the national process which might consider whether or not to licence foreign vessels, to the international scene which can include issues such as agreement on conservation measures. I also acknowledge that most large-scale management decisions are political decisions which are influenced by a diversity of social, economic and biological factors. Alternative reasons for these decisions include:

(a) To optimise, or maximise, economic return. Within this single category there are again alternatives:
  (i) to increase total revenue,
  (ii) to increase employment,
  (iii) to diversify the economy,
  (iv) to improve foreign exchange balances.
(b) To develop an alternative use of the resource; for example by targeting a different market such as changing from the cannery to the *sashimi* market.
(c) To restrict effort in order to conserve the resource or to remedy overcapitalisation.
(d) To displace foreign with national effort.

(e) For resource diplomacy, including improving the international stature of a nation or nations and for the promotion of regional harmony.

We must therefore acknowledge that the magnitude of the resource base is a limiting factor to total development of fisheries, but only one of many factors which influence fisheries management. We must also acknowledge the great differences between the numerous tuna species and therefore the resources that they constitute. In Tables 2 and 3 are examples of the differences among tunas and between tunas and other fish species, respectively.

Table 2. Some factors which influence the management of southern bluefin tuna (SBT) and skipjack (SJ) fisheries.

	SBT	SJ	Difference
Max life span	25 years	5 years	× 5
Natural mortality (M)	0.2	1.9	× 10
Max size	180 kg	30 kg[a]	× 6
Growth rate (K)	0.12	2.00	× 15
Spawning area	(1,000,000 km^2)	50,000,000 km^2	× 50
Spawning season	<4 months	12 months	×>3
Spawning frequency	Probably sporadic	Daily	
Migration/mobility	Highly migratory/ predictable	Highly mobile/ unpredictable	
Price/kg	$25/kg	$1.00/kg	× 25

[a]Only in some areas.

Table 3. Range within teleosts of parameters commonly used for population assessments.

	Natural mortality	K (von Bertalanffy)
Skipjack	1.9	2.0
Yellowfin	0.7–0.9	0.25–0.6
Southern bluefin	0.2	0.12
Clupeids	0.2–0.6	0.3–0.6
Salmonids	0.2–1.2	0.2–0.4
Gadids	0.1–0.5	0.1–0.3
Pleuronectids	0.15–0.25	0.07–0.3

The orders of magnitude of differences between two species in some basic population parameters are shown in Table 2. The huge range within the tuna family, particularly when compared with other fish species, is shown in Table 3. The difference in maximum metabolic rate between skipjack and yellowfin, two of the more similar species, is as great as between yellowfin and any other tuna species (Fig. 1).

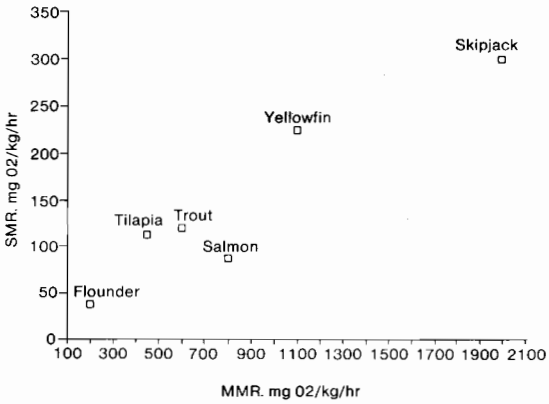


Fig. 1. SMR and MMR for various species (reproduced with kind permission from Dr. Richard Brill, Honolulu Laboratory, US National Marine Fisheries Service).

Management of the Major Species

Skipjack

The magnitude of the skipjack resource in the central and western Pacific is such that it appears immune to long-term decimation by fishing pressure even at levels considerably greater than those presently operating. Unfortunately, the ability of the total resource to support greatly increased catches has often been misinterpreted to imply that fisheries do not have any impact on each other. The resource is indeed great but not infinite and fisheries operating close to each other in either time or space could affect changes in catch rates without adversely influencing long-term total resource trends. The magnitude of the interaction between any two fisheries will be a function of the size of the respective fisheries, the exploitation rates in each fishery and the rate of interchange of the stocks exploited in each fishery. In most cases the rate of interchange is directly related to the distance (in space or time) between the fisheries. Interaction would be highest for fisheries of different gear types exploiting skipjack at the same time and in the same place, for example between concurrent pole and line and purse-seine fisheries operating in the same waters. It would usually be less for fisheries operating in different areas, such as the confines of individual national 200 mile zones, but even then fishing in zones which have common boundaries could result in high levels of interaction.

It is essential to differentiate between the relevant immunity of the total skipjack resource to overexploitation and the vulnerability of catch rates in specific areas to changes induced by heavy localised fishing pressure.

Yellowfin

The total yellowfin resource is much smaller than that of skipjack and, because of the nature of the species, more prone to fisheries-induced declines.

The only estimates of the size of the resource are, as yet, those available from the 1970s work by the SPC which was aimed primarily at skipjack. Great caution is therefore necessary in predicting future total yields, and catch and catch per unit of effort trends should be monitored carefully. The great difference in value between longline and purse-seine caught yellowfin and the catchabilities of this species by the two gear types necessitates more sophistication in economic analyses included in evaluation of optimum exploitation levels.

Experience in the eastern tropical Pacific indicates that yellowfin respond to increases and decreases in fishing pressure in accordance with classical fisheries population models, greatly facilitating the long-term management of the total resource.

Albacore

The decline in longline fishing effort in the Pacific Islands region since the early 1970s removed concern over the status of the total South Pacific albacore stocks. However, the recent intense competition for this species between the troll and surface gillnet fisheries south of the Pacific Islands region has necessitated consideration of total resource conservation and allocation. Current research interest is high in this species, and management strategies taking account of the need for conservation of the total resource and for allocation among gear types will undoubtedly be developed in the next few years.

Bigeye

So little is known of bigeye resources that little more than motherhood statements can be made about desirable management strategies. However, the species' ability to avoid extreme vulnerability at any stage of its life cycle would suggest that fluctuations in total abundance due to fishing effort are likely to be slow, therefore allowing time for management to respond. Careful monitoring of catch trends should enable rational long-term management.

Billfish

Because the major species of billfish are considered to be heavily exploited at present they are more likely to require management for conservation purposes in the short-term than are the major tuna species. However, because major catches of billfish are taken incidental to tuna catches, effecting management for the sake of billfish will be difficult. Conversely, if the management of billfish becomes critical to the extent that it determines, or even greatly influences, total tuna management policy, then the conservation of billfish could have an impact much greater than its present level of importance to total tuna and billfish landings in the Pacific.

Conclusion

There is no question that the tuna resource base in the South Pacific is great and that it will play a major role in national fisheries management policies, national development aspirations and international politics for many years to come. The resource is made up of a number of species, each of which has its own peculiarities necessitating individual and different management approaches for optimum utilisation. Further compounding management processes is the multi-species catches of the dominant gear types, particularly purse-seine and longline, and the enormous overlap which exists between gear types and areas. Even the bycatch from a purse-seine fishery for skipjack, for example juvenile yellowfin or adult marlin, could influence fisheries management on a much broader scale than merely within the 200 mile zone in which it is taken. Therefore even for skipjack which, from a biological viewpoint, should be the most simple to manage, a great deal of compromise and neighbourly cooperation will be necessary.

I have no doubt that a great deal of regional cooperation will be required for the successful management of the resource base of all tuna species in the Pacific. When one also considers the advantages in adopting common approaches to other aspects of fisheries management, such as licencing policies, enforcement networks and data bases, the roles being played by South Pacific regional organisations are endorsed as vital.

Property Rights Issues

Extended Zones of Jurisdiction over Marine Resources: State Practice in the South Pacific Region

B. Martin Tsamenyi and S.K.N. Blay[1]

Abstract

Negotiations during the Third United Nations Conference on the Law of the Sea (UNCLOS III) resulted in the emergence of a 'new' Law of the Sea, the details of which are set out in the 1982 United Nations Law of the Sea Convention (LOSC) text. One of the essential aspects of the 'new' law is the concept of extended zones of jurisdiction in the form of the Exclusive Economic Zone (EEZ). The emergence of the EEZ concept presents a major economic opportunity to many countries, particularly the developing coastal states. The economic benefits they stand to derive from exploiting fisheries resources in their EEZs have great potential in reversing some of their balance of payments problems. One group of countries that is benefiting significantly from the EEZ concept is the small developing South Pacific Island States (SPIS). Fisheries, especially the various species of tuna, are about the only resources some of them possess. Thus for the SPIS, many of whom have little or no land-based resources, the sea, and for that matter fisheries exploitation, is a matter of great importance.

On a worldwide basis, states are implementing aspects of the LOSC, particularly those relating to the exploitation of marine living resources in the EEZ. This paper examines the essential aspects of the EEZ and surveys the principal aspects of state practice in relation to the EEZ by the states in the Pacific Islands region. The aspects of state practice examined include legal claims to EEZs, enforcement of jurisdiction in the EEZ and agreements and arrangements for foreign access to the resources in the EEZ.

ONE of the most significant aspects of the Third United Nations Law of the Sea Conference (UNCLOS III) was the concept of extended zones of jurisdiction in the form of the Exclusive Economic Zone (EEZ) that was adopted and incorporated into the 1982 Law of the Sea Convention (LOSC). These extended zones of jurisdiction provide the basis for a coastal state to acquire extensive exclusive rights over the natural resources of its adjacent seas up to a distance of 200 nautical miles. In the conduct of international relations relating to the sea and the management of its resources, these zones represent the emergence of a new conceptual approach with significant benefits to the economies of coastal states. Nowhere is the significance of the zones and their potential impact on the economies greater than in the South Pacific region where the small and developing island states occupy and lay claim to some of the world's most extensive and richest fisheries stocks.

In the post-UNCLOS III period, fisheries are without doubt set to play a crucial role in the economies of most of the South Pacific Island states, given their unique location. A careful study of fisheries management in the region is therefore very appropriate in any analysis of their economies. Given the vital link between the concept of extended zones of jurisdiction and fisheries exploitation and management, any discussion must first begin with an analysis of the zones which provide a basis of the rights and obligations for states in relation to their marine resources. Such an analysis will provide a better understanding of some of the dynamics of

[1] Faculty of Law, University of Tasmania, GPO Box 252C, Hobart, Tas 7001 Australia

fisheries exploitation and management in the region. The extended zone of jurisdiction of relevance to fisheries exploitation and management is the Exclusive Economic Zone (EEZ). This paper will therefore discuss principally the EEZ and related forms of jurisdiction.

The EEZ

Article 55 of the LOSC defines the EEZ as 'an area beyond and adjacent to the territorial sea.' Article 3 allows each coastal state the right to establish the breadth of its territorial sea up to a limit of 12 nautical miles, measured from the baselines of its coast. On the other hand, Article 57 provides that the breadth of the EEZ 'shall not extend beyond 200 nautical miles from the baselines from which the breadth of the territorial sea is measured.' These three articles provide the basic framework for the delimitation of the EEZ. Indeed, their combined effects determine the exact breadth of the EEZ. Even though each coastal state may claim up to 200 nautical miles for its EEZ, the maximum limit for what one may call 'EEZ proper' is in reality 188 miles and not 200. This is because, since the EEZ begins from the outer limit of the territorial sea, the 200 nautical mile limit has to make allowance for a 'discount' of up to 12 nautical miles for the breadth of the territorial sea.

It is also the case that a coastal state need not claim the complete 200 nautical mile limit if it does not so wish. This is implicit in the fact that the 200 nautical mile limit is the maximum breadth that may be claimed. In any case, in some situations it may be physically impossible for a state to claim a maximum limit. The breadth claimable is obviously limited by the extent of the waters available to be claimed. For instance, where the extent of claimable waters between two adjacent states is less than 376 nautical miles, neither state may be able to claim the maximum limit.

Where the breadth of water between two adjacent states is less than the maximum claimable limit, the extent of the EEZ each may claim is a complex issue. The LOSC provides no useful guide or formulae for demarcation. Article 74(1) provides that '(T)he delimitation of the exclusive economic zone between States with opposite or adjacent coasts shall be effected by agreement on the basis of international law ... in order to achieve an equitable solution.' Where they fail to reach an agreement they are required to use the dispute settlement mechanisms provided under the Convention. The difficulty with these provisions is that they do not offer any formulae for demarcation. Thus, where the states are unable to agree, arbitration becomes the next avenue for the demarcation. In practice, however, there are relatively few disputes with demarcation. States generally resolve demarcation issues through bilateral agreements. As a general rule, states tend to use the equidistance rule as a basis for demarcation unless historical or geographical factors make it inequitable to use this method.

Rights of States in the EEZ

The EEZ is significant principally because of its living resources (i.e. fisheries) and nonliving resources (e.g. minerals). The LOSC gives specific rights in respect of these resources. Article 56(1)(a) provides the coastal state with four primary rights: exploring and exploiting, conserving and managing the natural resources, whether living or nonliving, of the waters superjacent to the sea-bed and of the sea-bed and its subsoil, and with regard to other activities for the economic exploitation of the zone, such as the production of energy from the water, currents and winds.

In addition to these, Article 56(1)(b) gives to the coastal state secondary rights to erect artificial islands, installations and other related structures for the economic exploration and exploitation of the zone, and jurisdiction in respect of scientific research and the protection of the marine environment.

Extent of Rights Over Fisheries

The rights over fisheries in the EEZ are regulated principally by the combined provisions of Articles 56, 61 and 62. While Article 56 gives the state preferential rights over the fisheries stocks in the EEZ, Article 61 gives the state the sole right to determine the *allowable catch* (AC) of the stocks in the zone. While the determination of the primary level of exploitation may be the exclusive right of the state, the issue is not purely subjective because the AC is itself determined by the *maximum sustainable yield* (MSY) of the stocks. The MSY is determinable by objective scientific evidence 'as qualified by relevant environmental and economic factors, including the economic needs of coastal fishing communities, and the special requirements of developing states, and taking into account fishing patterns, the interdependence of stocks and the generally recommended international minimum standards' (Article 61(3) LOSC). Admittedly these

qualifications make the MSY formula a composite one 'in which subjective judgements of an economic character modify judgements about verifiable ecological (and for that matter scientific) facts' (O'Connell 1982, p. 561). The element of scientific plausibility reduces the tendency of the coastal state to give arbitrary figures about its estimate of the AC.

Quite apart from the AC, the coastal state is also given the exclusive right to determine its *harvesting capacity* (HC) of the stocks in the EEZ (Article 62(2) LOSC). Once again, despite the element of exclusiveness, the matter is not entirely subjective. This is because the LOSC imposes an obligation on the coastal state to 'promote the objective of optimum utilization of the living resources' in the EEZ (Article 62(1) LOSC). Thus where the AC exceeds the harvesting capacity of the state, it is required under the LOSC to give access to other states to harvest the *surplus*. The surplus is thus the difference between the AC and the HC.

Given the interest of other states in the determination of the surplus, the coastal state cannot simply give out arbitrary figures about its capacity to harvest its stocks, particularly where it obviously lacks the determined capacity. This notwithstanding, the fact remains, however, that where the coastal state determines that its HC is equivalent to the AC, it can legitimately claim exclusive or monopoly rights over its fisheries stocks. It is, however, unlikely that any of the developing countries would be able to make such a determination given their present lack of technological and related resources for harvesting stocks. Indeed, it is rare for any country to make such a determination.

Allocation of the Surplus

Even though the LOSC imposes an obligation on the coastal state to allocate its surplus to other states, it does not provide any exact formulae for such allocation: Article 62(2) simply provides that 'where the coastal state does not have the capacity to harvest the entire allowable, it shall, through agreements or other arrangements...give other states access to the surplus of the allowable catch...' Article 62(3) goes a step further in stating that in allocating the surplus to other states, the coastal state shall take into account 'all relevant factors, including *inter alia* the significance of the living resources of the area to (its) economy...and its other national interests.' It is also to take account of the needs of the landlocked states, geographically disadvantaged states, developing states in the subregion or region, states with traditional fishing rights in the zone and states that have made substantial efforts in research and identification of the stocks.

It is not clear whether the catalogue of possible beneficiaries from the surplus is exhaustive or not and neither is it clear whether a state can by agreement allocate a portion of the surplus to another state (e.g. a distant water fishing nation (DWFN)) which does not fit into the catalogue. The list of beneficiaries is not exhaustive. This is implicit in the phrase 'including *inter alia*...' used in Article 62(3) to enumerate the beneficiaries. In any case, under Article 62(3) the relevant factors to be taken into account in allocating the surplus include two primary all-embracing factors: the significance of fishing to the economy of the coastal state and its national interests. The point at issue here is that the allocation of the surplus to a DWFN for commercial concessions or as part of a simple commercial contract can be justified under either heading. Presently, the common practice of coastal states signing fishing agreements with DWFNs irrespective of whether the DWFNs have traditionally fished or researched their zones makes this discussion virtually academic.

EEZ Distinguished from Fisheries Zones

It is now common practice for states to declare EEZs in pursuance of the LOSC (as of March 1986, 69 countries have claimed EEZs (Smith 1986, p. 3)). Nevertheless a substantial number of states have declared fisheries zones rather than EEZs (as of March 1986, 21 countries have claimed 200-mile fisheries zones (Smith 1986, p. 3)). The issue is whether a fisheries zone is the same as or equivalent to an EEZ.

The LOSC does not provide for a specific regime of a fisheries zone as such. It is therefore debatable whether a state can use the LOSC as a basis for claiming a fisheries zone. On the other hand, the point needs to be made that, since the EEZ gives states preferential fishing rights, it automatically incorporates the regime of a fisheries zone. Thus by claiming an EEZ, a state acquires a fisheries zone, but a state cannot acquire an EEZ by claiming a fisheries zone. The claiming of a fisheries zone on its own as opposed to an EEZ entails two principal disadvantages. On its own, the legal bases of the fisheries zone are rather dubious. Before the

conclusion of the LOSC, states generally adopted a 200-mile fisheries zone as an attempt to protect their interests 'at least on an interim basis pending the conclusion of the Law of the Sea Conference and in particular the fuller acceptance and definition of the concept of the EEZ...whether through the Convention or through the evolution of international customary law' (Moore 1985, p. 4).

With the adoption of the EEZ concept, the legal regime of the 200 nautical mile zone became well defined in international law. Many states simply transformed their fisheries zones claims to EEZ claims. Any fisheries zones subsequently claimed by these states thus derived their legal basis from the EEZs claimed. For states which continue to claim only fisheries zones, the legal basis of their claims is not clear.

In the Fisheries Jurisdiction Case (ICJ Reports, 1974, p. 23), the International Court of Justice appeared to have supported the notion of a fisheries zone but this was in 1974, well before the EEZ emerged as a legal concept. Today one cannot use the Court's decision to support the validity of a 200-mile fisheries zone claim. In that case, the Court did not explain the exact scope of a state's rights in the fisheries zone. It is also doubtful whether the Court intended to make the fisheries zone a general right in international law. Since a fisheries zone is not an EEZ as such, a claimant state cannot ascribe the rights and duties granted under the EEZ to its claims of a fisheries zone.

A fisheries zone on its own has the added disadvantage of being restrictive. Unlike the EEZ which provides rights for the coastal state over living and nonliving resources, a fisheries zone only provides jurisdiction over fisheries exploitation and does not cover the exploitation of nonliving resources. Given the extensive benefits in claiming an EEZ and the fact that the EEZ incorporates a fisheries zone, it seems more prudent for a coastal state to claim an EEZ rather than a fisheries zone.

Practice in the South Pacific Region

This part of the paper examines state practice in the South Pacific region with regard to extended zones of jurisdiction over marine resources. The South Pacific region is usually defined to include all the developing island countries and non-self-governing territories within the South Pacific Commission region. For the purpose of this paper, the South Pacific region covers the developing island states within the South Pacific Commission region that are parties to the South Pacific Forum Fisheries Agency Convention. These include: Cook Islands, Fiji, Kiribati, Nauru, Niue, Papua New Guinea, Solomon Islands, Tonga, Western Samoa, Vanuatu, Federated States of Micronesia and the Marshall Islands. The examination will focus on (i) categories of zones of extended jurisdiction, (ii) enforcement of jurisdiction within the zones and (iii) legal arrangements for allowing access to the zones.

Categories of Zones

All the South Pacific Island States (SPIS) have extended their maritime zones of jurisdiction beyond the traditional territorial sea limit. While some claim EEZs, others claim only fisheries zones.

EEZ Claims Nine countries in the South Pacific region have laid claims to EEZs. The countries include the Cook Islands, Fiji, Kiribati, Niue, Solomon Islands, Tonga, Tuvalu, Vanuatu and Western Samoa. Table 1 sets out the years in which each claim was made and the relevant legal basis for the claims.

The EEZ claims of the SPIS are substantively similar. All the claims conform to the provisions of the LOSC in terms of the maximum breadth of the EEZ. The delimitation of the EEZ between opposite or adjacent states, as required by LOSC, has not yet been carried out in the South Pacific region. (The South Pacific States are currently holding consultations among themselves under the auspices of the Forum Fisheries Agency to work out programs for delimitation of their maritime zones (for details, see FFA Report No. 88/66; 88/46.)) All the relevant legislation of the SPIS on EEZs therefore makes provision for breadths less than the required 200 nautical miles subject to demarcation agreements.

Table 1. EEZ Claims by South Pacific states (source Moore 1984).

Country	Year of claim	Legislation
Cook Islands	1977	Territorial Sea and Excl. Econ. Zone Act
Fiji	1977	Marine Spaces Act
Kiribati	1983	Marine Zones (Dec.) Act
Niue	1978	Territorial Sea and Excl. Econ. Zone Act
Solomon Islands	1978	Delimitation of Maritime Waters Act
Tonga	1978	Territorial Sea and Excl. Econ. Zone Act
Tuvalu	1983	Marine Zones Decl. Ordinance (not yet in force)
Vanuatu	1981	Marine Zone Act
Western Samoa	1977	Excl. Econ. Zone Act

Fisheries Zones Claims The countries that claim fisheries zones include the Federated States of Micronesia (FSM), the Marshall Islands, Nauru, Palau and Papua New Guinea (PNG). Table 2 sets out the years in which these claims were made and the relevant legislative basis for the claims.

PNG's claim seems anomalous and therefore requires special mention. We have classified PNG's claim as a fisheries zone contrary to the general tendency by commentators (e.g. Doulman 1986, p. 9) and PNG government officials to describe the claim as an EEZ. The relevant PNG legislations laying claim to marine zones are the National Seas Act, 1977 and the Offshore Seas Proclamation Act, 1978. The former legislation made provision for the demarcation of the internal waters, the territorial sea, the 'offshore seas' and the archipelagic waters of PNG. The 'offshore seas' are defined as extending to a distance of 200 nautical miles seaward from the territorial sea baselines (Section 6, Offshore Seas Proclamation Act, PNG). The Act does not mention the jurisdictional competence of PNG in the 'offshore seas.' The 'offshore seas' were later proclaimed by the Governor-General as a fishing zone in 1978 (PNG Gazette, 30 March 1978). This proclamation was enacted into law in 1978 as the Offshore Seas Proclamation Act.

Table 2. Fisheries zone claims by the South Pacific states (source Moore 1984).

Country	Year of claim	Legislation
FSM	Not known	Title 52, Trust Territory Code
Marshall Islands	1978	Marine Resource Jurisdiction Act, 1978
Nauru	1978	Marine Resources Act, 1978
Palau	Not known	Public Law No. 6-7-14, as amended by Law No. 6-65-8
PNG	1977, 1978	National Seas Act 1977; Offshore Seas Proclamat. Act, 1978

Smith (1986, p. 34) concludes that it is 'unclear as to the type of jurisdiction being claimed' by PNG under the Offshore Seas Proclamation Act. In our view, it is clear from the combined reading of the National Seas Act, the fisheries zone proclamation of the Governor-General in 1978 and the Offshore Seas Act that PNG did not claim an EEZ but a fisheries zone. One may legitimately classify PNG's claim as an 'offshore sea' (Tsamenyi 1988, p. 256), but since the 'offshore sea' concept is unknown to international law we prefer to classify PNG's zone as a fisheries zone. It is desirable that PNG officials take the necessary steps to remove any uncertainties with regard to the type of zone being claimed.

There is a tendency to categorise all the zones of extended jurisdiction claimed by the SPIS as EEZs. This approach is often justified on the grounds that there is a move towards a near universal claim of EEZ by the SPIS and that, in any case, those SPIS that have not yet declared EEZs are in the process of doing so as part of their overall LOSC implementation process (Tsamenyi 1988, p. 256). It is conceivable that these fisheries zones may later be transformed into EEZs. However, it is misleading to equate a fisheries zone with an EEZ as the discussions above have shown.

It is in the interest of the SPIS that have not declared EEZs to do so. The process of claiming an EEZ is not cumbersome. The existing fisheries zone legislation can easily be modified to apply to the EEZ. As we have shown, the EEZ has a number of advantages over fisheries zones. The specific international law rules on the rights of coastal states over their marine resources, and the enforcement powers they possess over foreign fishing vessels are all derived from the EEZ provisions under the LOSC. It is arguable that in the absence of actual claim to the EEZ, a state may not avail itself of the protection of international law. In any case, it makes good economic sense for every state to claim an EEZ, since a state's jurisdiction in the EEZ covers all types of resources, both living and nonliving, marine scientific research and the protection and preservation of the marine environment (Article 56(1), LOSC), whilst jurisdiction in the fisheries zone is limited to fisheries resources only.

A claim by all the SPIS to EEZs will be consistent with the philosophy of regional cooperation in fisheries matters in the region and the objectives of the Forum Fisheries Agency Convention to achieve harmonisation of fisheries laws and policies in the South Pacific region. These objectives will be better realised if all the SPIS make uniform marine claims.

Enforcement of Jurisdiction

The immediate practical problem that faces any country that claims an EEZ or a fisheries zone, therefore, is that of enforcement of jurisdiction within the zone. It is not enough to enact domestic

legislation or make presidential proclamations asserting resource jurisdiction over the oceans. To achieve maximum economic benefits from the zone the coastal state must be capable of effectively enforcing its jurisdiction over foreign fishing vessels within the zone. Enforcement of jurisdiction in the zone of extended jurisdiction becomes the ultimate test of its reality. The standard strategy adopted by many states that have declared EEZs and fisheries zones is to enforce jurisdiction through physical means. This normally involves the use of patrol vessels and aircraft to police the zone. However, the effectiveness of this strategy depends on the physical and financial capabilities of the coastal states.

A number of factors militate against the use of physical strategies by the SPIS to enforce jurisdiction in their EEZs and fisheries zones. The first factor is the size of their zones. Extension of their maritime jurisdiction has resulted in a dramatic increase in the areas of the oceans over which the SPIS have claimed jurisdiction. Apart from PNG all the SPIS have small land territory. Nearly all of the SPIS are smaller than 100 square nautical miles. In contrast is the massive ocean space over which they claim resource jurisdiction. The ratio of land to sea (expressed in square nautical miles) ranges from 1 to 72 in the case of PNG to 1 to 30 214 in the case of Tuvalu (Tsamenyi 1988, p. 256). Policing this much ocean space effectively is, both physically and financially, an impossible task for any SPIS.

The second factor that makes it difficult for the SPIS to enforce jurisdiction in their EEZs and fisheries zones through physical means relates to the weakness of their economies. The effectiveness of physical surveillance of maritime zones depends largely on the financial capabilities of the coastal states. Here too, the SPIS are greatly handicapped. All the SPIS may be classified as developing. As such, they are characterised by very weak economies. As a result they cannot afford the high cost of physical enforcement of jurisdiction by employing sophisticated gadgetry, patrol vessels and skilled personnel. Among the SPIS, only PNG and Fiji are able to maintain physical force of some significance. But even this is not sufficient to enable these countries to police their EEZs and fisheries zones effectively.

The SPIS have sought to overcome the constraints that militate against their effective enforcement of jurisdiction in the EEZ and fisheries zones by cooperating with each other through the Forum Fisheries Agency (FFA). One of the objectives of the FFA is the achievement of 'cooperation in surveillance and enforcement' (Article 5, FFA Convention). In pursuit of this objective, the FFA secretariat is assigned the duty to work towards the development of regional surveillance strategies. This effort culminated in the setting up of a Regional Fisheries Surveillance and Enforcement Programme in 1986. The program is aimed at enhancing the surveillance and enforcement capacities of the SPIS through a number of strategies, including: the provision of technical assistance to governments, encouraging cooperation in surveillance activities, collecting and analysing reports of foreign fishing vessel activities in the region and the establishment of training programs (FFA 1986–87, p. 9).

There are, however, important cost-benefit factors to be taken into account in promoting physical enforcement of jurisdiction in the EEZ even at a regional level. Investment in physical enforcement of jurisdiction may not be justified by the revenue to be obtained from the fisheries resources in the zone. In fact, 'the cost of operation of a normal patrol craft, for example, quite apart from capital costs, can often exceed the total revenue that the Coastal State may expect to receive from foreign fishing operations' (Moore 1986b, p. iii). At a theoretical level, 'the adoption of effective controls can be viewed as a question of the protection of the national sovereign rights over the resources of its 200 mile EEZ, which should not be dependent on the outcome of any cost-benefit analysis' (Okatsu 1986). However, 'in practice many developing Coastal States (including SPIS) are viewing critically the outlay of financial resources and manpower required and are unwilling to spend more on surveillance and enforcement than they are likely to gain in benefits from effective controls' (Okatsu 1986). Accordingly, the SPIS, under the auspices of the FFA, are devising new strategies that overcome the need physically to police their zones. Much emphasis is being placed on compliance control, i.e. strategies to ensure that licenced fishing vessels comply with the terms and conditions of the licencing agreement. Two such strategies being utilised by the SPIS include Increased Flag-State Responsibilities and the Regional Register.

The concept of flag-state responsibility is designed to compel the flag-state to accept some degree of responsibility for the compliance of its vessels with the fisheries laws and regulations of the coastal states. This concept is gaining widespread recognition in the fishing practices of many states.

Provisions are now almost automatically included in access agreements reflecting this fundamental principle. Some DWFNs have also implemented the principle in domestic law. For example, in Japan, the implementation of the flag-state responsibility currently involves a system of worldwide location controls over Japanese vessels, a worldwide annual enforcement patrol, and the principle that unauthorised entry into coastal state waters is an offence under Japanese law where there is an agreement with the state in question (Okatsu 1986).

The Regional Register was introduced in September 1983 and provides a data base which lists all vessels fishing in the EEZs of any FFA member state. The register operates on the basis of 'a good standing' concept. The SPIS have agreed not to licence any foreign fishing vessel to fish in their EEZs unless that vessel has 'good standing' status on the Common Register. 'Good standing' is accorded by the director of the FFA to fishing vessels that comply with the licencing requirements and fishing laws and regulations of any SPIS. The requirements of the regional register have been incorporated in a number of access agreements entered into by the South Pacific states with DWFNs (see Doulman 1986).

These nonphysical enforcement measures have certain limitations. They are not effective against unlicenced or illegal fishing activities by foreign fishing vessels. Exact knowledge of illegal fishing in the EEZs and fisheries zones of the SPIS is not known given the expanse of water under the jurisdiction of these countries. Although the available information indicates that illegal fishing is not a major problem in the South Pacific region, the countries are, nonetheless, supplementing their nonphysical enforcement strategies with some degree of physical force (for a discussion of the situation in the various SPIS, see Bergin 1988, p. 49). Ultimately the extent to which the SPIS resort to physical enforcement of jurisdiction will be determined by the cost-benefit factors discussed above.

Allocation of Fisheries in the Zones

International law requires that, where a coastal state is unable to fully exploit the living resources within the EEZ, it shall, through agreements and other arrangements, allow foreign states to exploit the surplus of the allowable catch (Article 62(1), LOSC). In line with this legal requirement which is an economic necessity, the SPIS have entered into agreements with several DWFNs to exploit their fisheries resources. These agreements are of significant benefit to the SPIS in that they provide them with valuable foreign exchange to supplement their meagre revenue from other sources. Three basic types of 'agreements' or arrangements are utilised by coastal states in the South Pacific region. These are: bilateral agreements, multilateral agreements and to a limited extent, joint venture agreements.

Bilateral Agreements

Bilateral fisheries agreements are those agreements entered into between the coastal state and a DWFN or a foreign fishing company. The former may be termed a government to government or intergovernmental bilateral agreement and the latter a government to industry agreement.

As the SPIS do not have the capacity to exploit their fisheries resources on their own efforts, they have entered into bilateral fisheries agreements with DWFNs. Most of the SPIS have bilateral agreements with one or more DWFN or foreign fishing company (Doulman 1986). In 1986, the only SPIS that did not have bilateral fishing agreements with any DWFN were Fiji, Tonga, Vanuatu and Western Samoa.

For the SPIS, the bilateral agreements serve as instruments for securing a broad range of economic benefits from foreign fishing activities in their zones of extended jurisdiction. The agreements also provide the framework for the management and conservation of their fisheries resources. These agreements regulate a broad range of issues such as formulae for calculating fees, the requirements for fishing licences, enforcement of jurisdiction and management and conservation measures (Moore 1985, p. 1-26).

Government to government bilateral fisheries agreements are preferable to government to industry agreements. First, government to government bilateral agreements provide the framework for the granting of other economic concessions or other benefits such as increased market access. Further, the conclusion of government to government access agreements provides occasion for enlisting the support of the flag-state in ensuring that its vessels comply with the terms of the agreement and with the laws of the coastal state concerned (Moore 1986a, p.10).

Multilateral Access Agreements

A trend is emerging in the South Pacific towards the conclusion of multilateral fisheries agreements with the dominant DWFNs operating in the region. This trend, which is unprecedented in the history of international fisheries regulation emerged with the signing of the Treaty on Fisheries with the United States of America. Under the multilateral treaty approach, the SPIS collectively allow licenced U.S. fishing vessels access to their EEZs and fisheries zones, subject to certain regulatory controls and conditions; the most important part being payment of licence fees by the USA on behalf of its fishing vessels. Revenue from this agreement is distributed to the SPIS party to the treaty by the FFA according to an agreed formula (see Schedule 1, Agreement Among Pacific Island States Concerning the Implementation and Administration of the Treaty on Fisheries Between the Government of Certain Pacific Island States and the Government of the United States of America).

The negotiation of multilateral fisheries access agreements is an advancement on the orthodox bilateral agreements. A multilateral access agreement has a number of advantages. First, all the SPIS party to the treaty are entitled to a portion of the revenue from the agreement irrespective of whether any fish has been caught in their zones. Second, a multilateral approach removes the problems associated with negotiating a bilateral treaty by maximising scarce resources. Third, a multilateral approach is consistent with the philosophy of regional cooperation in fisheries management in the South Pacific region. Finally, through a multilateral approach, the SPIS constitute a political bloc which enables them to exercise influence and leverage in their negotiations with DWFNs.

Despite the complexities that may be involved in getting a group of countries to harmonise their fisheries policies and to agree to a formula for allocating revenue from a multilateral fisheries agreement, the multilateral approach offers the best framework for the SPIS in the exploitation and management of their fisheries stocks. However, the treaty with the USA must always be considered within the political circumstances leading to its negotiation (see Tsamenyi 1986b). It is highly unlikely that any other DWFN would be willing to follow the U.S. example as the unique political relations between the SPIS and the USA that facilitated the treaty are absent in the relations between the SPIS and other DWFNs. It is hardly surprising that the ongoing negotiations with Japan to sign a similar treaty have not yet produced fruitful results.

Joint Ventures

Joint venture agreements have been increasingly used in other parts of the world as instruments for securing access by DWFNs to the 200 mile zones of coastal states. The advantages in a joint venture approach are that it allows the coastal state to participate in a fishing venture according to its own capacity without first having to master the technical and managerial skills needed to run the venture (Christy 1983, p. 6). However, a joint venture approach to fisheries exploitation has certain inherent drawbacks which makes it unsuitable for developing countries.

The situations in which a joint venture offers good prospects are relatively few because of the number of conditions that must be fulfilled. The first is an adequate, marketable resource. Even if a resource is available, it may require careful choice of foreign partner to assure access to favourable markets.

The technical feasibility of a joint venture is much more complex than that of a foreign distant water operation. The technology used is typically that possessed by the foreign partner, which is frequently poorly suited to the aptitudes and technical preparation of the local labour force. The foreign technology will also usually require elaborate infrastructure (assuming a locally based operation), which few developing countries possess. Attempts to create the infrastructure as part of the joint venture have frequently turned out to be more than the enterprise could afford. Attempts to do without the infrastructure have run into very high operating costs and/or loss of production due to excessive repair time.

A final major requisite for a successful joint venture is capable management. What constitutes good management is endlessly debatable, but the effects of bad management are not: loss of sea time, inability to keep good skippers, lower catches, poor product quality, lower prices and large losses. Many coastal states are under the impression that the foreign partner will supply the management. If the partner is well chosen, this is true to a certain extent, but the local partner must contribute to good management as well. If the partners do not, they are unlikely either to assure themselves proportionate benefits from it. An inexperienced partner can also

interfere with the competent management provided by the other partner, thus nullifying its effects (Christy 1983, p. 7).

Given the shortcomings, it is not surprising that joint ventures as instruments for fisheries management and utilisation have not been popular in the South Pacific region. Although there were modest efforts by some of the SPIS (PNG, Palau, Fiji and Solomon Islands) in the 1970s to enter into joint venture agreements with some DWFNs, these have not been very successful. In fact, by early 1984 the operations in PNG and Palau were virtually closed (Clark 1985, p. 15). Only the joint venture agreement between Solomon Islands and the Taiyo Fishing Company of Japan seems to have operated successfully (Clark 1985, p. 15). The outlook for joint ventures as vehicles for fisheries exploitation in the South Pacific region does not look promising.

References

Bergin, A. 1988. Policing the fishing grounds. Pacific Islands Monthly, June 1988.

Burke, W. 1984. Highly migratory species in the New Law of the Sea. Ocean development and International Law, 14(3).

Christy, C. 1983. Forms of foreign participation in fisheries: Coastal State Policy. Fisheries Law Advisory Programme, FAO, Circular No. 2, Rome.

Clark, L.G. 1985. South Pacific Ocean Fisheries. FFA Report 85/2, January.

Doulman, D. 1986. Fishing for tuna: the operation of distant water fleets in the Pacific Islands region. Pacific Islands Development Programme, Research Report Series No. 3, East-West Center.

FFA. 1986–87. Forum Fisheries Agency. Approved Work Programme and Budgets.

Moore, G. 1984. Regional Compendium of Fisheries Legislation (Western Pacific Region). Vols. 1 + 2, FAO, Rome.

1985. Coastal State Requirements for Foreign Fishing. FAO, Legislative Study No. 2, Rev. 2, Rome.

1986a. Principles of Fisheries Legislation under the New Law of the Sea. Fisheries Law Advisory Programme. Circular No. 5, FAO, Rome.

1986b. "Preface" in Fidell, E.R., Okatsu, M., and Meseguer, J.L. Flag State Measures to Ensure Compliance with Coastal State Fisheries Regulations. The United States, Japanese and Spanish Experience. Fisheries Law Advisory Programme, Circular No. 6, FAO, Rome.

O'Connell, D.P. 1982. The International Law of the Sea. Vol. 1. Clarendon Press, Oxford.

Okatsu, M. 1986. Japanese controls over their Distant Water Fishing Operations. Fisheries Law Advisory Programme, Circular No. 6, FAO, Rome.

Smith, W.S. 1986. Exclusive Economic Zone Claims: An Analysis and Primary Documents. Martinus Nlhjhuff, Dordrecht.

Tsamenyi, B.M. 1986a. The Jeanette Diana Dispute. Ocean Development and International Law, 16, 4.

1986b. The South Pacific States, the USA and Sovereignty over Highly Migratory Species. Marine Policy, January.

1988. The Exercise of Coastal State Jurisdiction over EEZ Fisheries Resources: The South Pacific Practice. Ambio 17, 4.

Evolution of Individual Transferable Quotas as a Distinct Class of Property Right

Anthony Scott[1]

Abstract

The theme of this paper is that Individual Transferable Quotas (ITQs) are on the way to emerging as a distinct class of interest in a natural resource. Furthermore, they have emerged in a novel way, evolving from regulatory licencing. Because of this origin, they will not develop as full-blown property rights unless those responsible for regulatory regimes take the initiative.

After stating what private fishing property rights were under common law, and how their evolution got stalled, the emergence of quotas from limited and regulated licencing is described. These quotas are shown to be merely a better instrument of regulation. The argument is offered that they lack the essential 'characteristics' of other property rights, including what is needed to be pooled or assembled for the management of land or natural resources. How they can be improved with these characteristics is also suggested.

Part I. Outline

In Part II it is shown how types of standard property rights can be distinguished by the 'characteristics' combined in them. Then the traditional ways by which they have emerged are compared. In Part III a view is advanced to explain why new fishery property rights have not been provided by these traditional channels. In Part IV it is argued that, unlike other kinds of property rights, quota rights have evolved from fishery regulatory institutions. In Part V I return to the idea of characteristics, pointing out that the new quotas still need more of three characteristics to become a basis for fisherman/stock management.

Part II. How New Property Rights Have Emerged

A. What is a Property Right?

What most people think of as a right to land or natural resource is, more precisely, a person's real interest. The word real means (as in the phrase 'real estate') it pertains to immovable things like the soil, resources and buildings and not to personal, movable things like livestock, equipment or vessels.

Many kinds of interest in land could be invented. But the courts of most countries recognise only a few which we might describe as standard interests. For example, there is an interest generally known as a freehold interest. Other standard interests, known especially in common-law countries, are leasehold, easements, and profits, and some related interests such as strata or condominium titles, mining rights, rights of fishery, and appropriative water rights. Other systems of law recognise a few other standard interests in land, water or resources.

All standard interests are territorial, so that the holder or owner of such an interest can use or manage a resource only within specified boundaries. However, most of them are also limited as to what can be done within the boundaries, how it is to be paid for, and so on. Thus any right of fishery is limited spatially and also with respect to details about season, species of fish, and gear to be used. These stipulations are usually not mandatory in a standard interest, but are set out or agreed upon

[1] Department of Economics, University of British Columbia, 997-1873 East Mall, Vancouver, B.C., Canada V6T 1W5.

when it comes into possession by grant, purchase, inheritance or rental.

Some of these standard interests can be owned outright, while others — such as most riparian water rights, rights of fishery, easements and rights to use a common — come along with the ownership of interests in other lands. Standard rights are generally valid in disputes about rights of possession and use as against third parties and indeed as against everyone. The terms or covenants attached to them when one party grants them to another thus become a kind of minor property law in themselves, binding on society as a whole.

To a greater or lesser extent, any interest in any kind of property conveys a power to manage, a power to receive income, and a power to alienate or sell. The extent to which a standard interest in land conveys any of these three powers depends in turn on the amounts of the 'characteristics' it combines. These are more fundamental than the standard interests, and can be used to describe rights or interests created by statute, and rights making up systems of property outside common law altogether. There are at least six characteristics. It is useful to regard the amount of each in a standard interest as observable, measurable, and continuously variable. For example, each might run from 0 to 100%. Other writers have the same idea, but indicate the quantity in qualitative and rather value-laden terms such as 'incomplete,' 'imperfect,' 'attenuated' or 'property-ness.' I find the following list adequate to convey the idea of characteristics:

1. Duration;
2. Flexibility;
3. Exclusivity;
4. Quality of title;
5. Transferability;
6. Divisibility.

A useful way of visualising a combination of characteristics in a standard interest in possession or use of a particular parcel of land or water is to regard each as measured in its own dimension and along its own axis. Consider the interest acquired by the holder of, say, a fishing licence, conveying rights to try one's luck at a certain place at a given time. This interest, in that place, would have particular, small, amounts of each of the six characteristics. For example, the amount of exclusivity enjoyed by the fisherman would depend not only on what interest he had in the fishery, but on the number of other potential functions or activities, such as navigation, at each location. A fishing licence does not normally protect from disturbance by boats and other users; but it might nevertheless give 100% 'exclusivity' wherever the water was too shallow for navigation. On another river it might endow its owner with more or less of each of the characteristics. Each of the standard interests, alternatively applied to that parcel of land and water, can be visualised as a six-pointed star-shaped figure formed by joining its measured points on the six characteristic axes. The characteristics and the diagram are developed in forthcoming work. A star-shaped figure can also be drawn to illustrate the *general* differences between two interests, in all locations. Economists will understand that the measured dimensions are not necessarily independent.

B. The Gain from Increasing the Characteristics

The following notes help to define four of these characteristics by suggesting how increasing one of them can increase the value of and the demand for a standard fishery right. For brevity I pass over here the problems that increasing the amount of one characteristic may (a) require changing the amounts of others to obtain an optimum combination, given (b) the costs of changing the amounts and (c) the costs of the transactions associated with the respective amounts.

Duration Measured in years, this characteristic measures the period over which the right-holder can profitably invest in harvesting, and/or in 'saving' fish stock for later harvesting by conservation or habitat enhancement.

Exclusivity Measured by the inverse of the number of parties with whom fishermen must contract to internalise their enterprises, increases in this characteristic reduce harvesting and investment conflicts. An increment of exclusivity may reduce the rewards to destructive rivalry between vessels. It can increase the fisherman's returns to participating in joint protection and fish-locating projects, and reduce both the cost of information about other owners and their intentions, and also the need for it.

Transferability (also referred to as marketability, tradeability, exchangeability and assignability) Measured by the number of parties to whom a right may possibly be sold or rented, a high value would indicate that fishing rights can be sold or bequeathed well beyond the original social group, or without being attached to a particular boat. Fishing rights gain value from tradeability by encouraging the use of markets in rights and other things to take advantage of fishermen's personal comparative advantage and/or of opportunities to retire. Other values are discussed below.

Divisibility This is an aspect of transferability, and has a number of meanings. ('Divisibility' can refer to the number of joint holders of one fishing right, or to the subdivision of a fishing territory.) It is valuable if it allows the holder of a right to transfer part of a season, or part of the range of catchable species, to another party.

C. How do New Property Interests Emerge?

The introduction of new real property rights can be thought of as the changing of the amount of one or more of the characteristics in a standard interest in land. For example, as an open-access regime on land or water changes from a profit-a-prendre, allowing people to graze animals or to fish, to a quota, granting them a 10-year, tradeable, quantitative interest (such as a profit-a-prendre), the diagram would show a small figure close around the origin swelling outwards in at least four dimensions.

In terms of historical political process, the adding or deleting of characteristics has generally been accomplished in one of four ways. The first two, informal, processes are together sometimes referred to as 'spontaneous,' by which some rights have been introduced by revolutions and conquests while others have emerged from the working of custom and common usage. The third and fourth processes have usually been incremental, adding characteristics to exisiting standard interests. The third process results in judge-made rights, emerging from litigation. A final, fourth, process has created characteristics by imperial, political or bureaucratic means, all of which we might refer to as 'legislation.'

If we think of those who participate in the 'production' of new property rights as being either demanders or suppliers, we can adapt familiar demand and supply notions to the process. We then observe that demand for new property characteristics has confronted supply in four 'market' arenas: in the villages and manors where custom is the law; in conquered and lawless lands; in the courts; and in the legislating organs of government. The demanders are parties who seek relief from the constraints of an existing standard interest. This is the same as saying that they demand some change in the combining of one or more of its characteristics. Why they seek the change when they do, the extent of the demanded change, and the amount they are willing to pay for it, are matters we cannot pursue here. In general, the absence of some characteristic has begun to cost them more profit or rent than before (Demsetz 1967). The suppliers are institutions, persons and groups who can add to or subtract from the characteristics in existing rights. Why they respond to demand when they do, the extent of the change they provide, and the reward they would ask, are questions we can barely touch on here.

1. Custom Under the prefeudal and feudal systems, the English lord and his lord would possess and rule large areas containing villages and towns. The division of land rights between them and the king, and each other, was subject to whatever land law there was. But in Saxon and early Norman times, subject to their lord, the individuals' rights over land were a strictly local matter. How many animals could be pastured, where and when, and how many and which strips cultivated was laid down in customary rules. Conflicts were resolved in local bodies generally called the village courts. Custom was fluid, and changes in the individuals' interests could be accomplished locally. As a general rule, the royal courts did not interfere with, but deferred to, customary law and rights.

Rights of fishery per se were not part of this customary English law. The right of fishery was a common-law interest allowing exclusive catching of fish in a specified stretch of a river, limited perhaps in species and dates. It was assumed that it had been owned in the past by a lord, and that he had once granted it to a person, a town, abbey, or village. Alternatively, he may have kept it, allowing villagers or others to fish for a fee or feudal service, as though it was his flour mill or ferry boat. Only in those few villages to which the lord had granted a common fishery ('pescary') similar to a common of pasture were there customary rules about sharing and preserving the fish. The fisheries laws and rights in continental Europe were somewhat different from those in common-law England. I owe to Professor Richard C. Hoffman a detailed bibliography, and remarks, on the differences.

In the early middle ages, in many jurisdictions, the fisheries were regarded less as a real property interest than as a regalian or public right. Princes and others holding such regalian rights could issue them to individuals and to communes: detailed Austrian ordinances for such fisheries survive. It appears that in some places local custom might determine how a commune's rights were distributed. Where it did, then local custom might also change individual rights.

During the later middle ages, to paraphrase a communication from Professor Hoffman, rights over fisheries, like those over wild game, slowly and incrementally slid from public authority, as above, to that of landowners. In the process the actual exercise by ordinary peasants of a right to fish often yielded perceptibly to that of 'professional' or commercial fishers (having the economic and social status of peasants). In south Germany, for example, the fishers, owing their rights to an owner/lord, had some voice in the management of his resource. I have so far come across no reference to such a class in England, and the general implication of English literature is that the fishery was used everywhere for subsistence by villagers, abbeys, and urban owners (Postan 1972). The south German fishers sometimes formed guilds, concerned with fishery management. 'In consequence, of course, some dwellers beside fish-bearing water could lose all rights to its use.' This outcome was certainly similar to the continuing situation of English villagers, who may never have had a right of fishery (Hatcher 1954).

Tidal fishery rights in estuaries and on beaches were not unlike those inland, and were not necessarily attached to neighbouring villages. We know almost nothing about rights to fish off shore. A preliminary judgment would be that in most common-law river and sea fisheries, custom had little role in enforcing or in changing the individual fisherman's rights.

2. Spontaneous and violent means The characteristics of interests in land have sometimes been drastically and discontinuously changed by conquests and uprisings. The best-known common-law example is the replacement of the Saxon land institutions mentioned above by William's Norman feudal structure.

William granted or regranted much of England to his loyal friends and lieutenants. Some lands and waters he reserved as boroughs, forests, or for his own domains, earldoms and the like. From these royal holdings his heirs continued to make grants, including, as above, grants of private rights of fishery.

A violent, out-of-sequence, event took place in the reign of King John. Like his predecessors he had been granting rights of fishery to favoured lords (and, probably, towns) especially in tidal waters — estuaries — where the rivers and fisheries were not yet in the legal possession of the local lords. To enjoy these grants, his grantees usually placed weirs and other works, some probably to catch large quantities of fish, perhaps for sale. The landed barons found these new royally granted fisheries obnoxious — challenging their own claims to granting powers and preventing their own projects. Probably they interfered with the lords' control over river navigation. Whatever their motives, in the dramatic Runnymede confrontation, the rebellious barons insisted John include in Magna Carta a promise not to grant fisheries in tidal and salt water. John complied. He would no longer give the power of granting tidal fishing rights to the barons or the towns. Since then, the resulting ownership vacuum has become familiar as the 'public right of fishing.' It is the result of a forceful termination of a common-law right to grant a fishery as a private interest. The barons demanded less (zero) exclusivity in crown-granted tidal fishing rights. Some say this restored an earlier Saxon or Celtic customary open access to tidal fisheries (for discussion of the Magna Carta decisions, see McGrady 1975).

3. Courts and the law of property — the judicial process as a supplier More conventionally than custom or conquest, changes in common-law interests in land and water emerge from a formal judicial process. Real property rights that are unsatisfactory to resource owners, their tenants or to third parties give rise to friction and conflict, or to frustration of attempts to use land in certain ways, or to unwelcome transaction expenditures. Many of these disputes ripen into legal actions. The courts do not merely decide on litigants' boundary questions but on questions of possession. Decisions in property cases become precedents for later, similar, cases. These precedents, when confirmed, can harden into new rules, new interpretations of the characteristics of the disputed standard interests. The changing common law of property is largely embodied in the changed characteristics of standard rights. This process continues and can be viewed in retrospect as a *litigative* means of developing new property rights.

The judges and the courts are the suppliers and they hear from the claimant demanders. The demanders' transactions costs include the demanders' own lost time, legal fees and courts charges. The total amount of these costs is largely determined by the opposition mounted by those who would be harmed by decisions adverse to them. Their losses are the social opportunity costs of the decision sought by the demanders. Depending on how easily a defense can be mobilised, these social or distributional losses may power the delay or stopping of the demanders' suits. (For example, losers must realise how and how much a decision would harm them. They must also find others in the same class. Some at least must have standing in court. They must determine whether to carry free riders.)

The casebooks show that from Norman times to the 19th century it was the courts that shaped standard rights to land. The process became easier when the courts, multiplying in number and jurisdiction, in effect competed with each other and with the government for land-law business. This did not happen with sea fisheries, as we discuss below.

4. Kings and Governments: legislation Another conventional channel is open to the parties. Instead of going to court, demanders can seek new legislation or ordinances from the state. A 16th century example is the grant of monopoly fishing rights to court favourites by the Tudors. They, along with their European counterparts, had claimed sovereignty over the high seas. The power to carve rights out of the Crown domains, and also a power to create new private fishing interests, had descended by the 19th century from kings to politicians and bureaucrats. A supply decision could be made by legislators.

Their decisions about supplying new characteristics became heavily political, dominated by consideration of the opposition of those who might lose from the suggested change in rights. Politicians typically translate such losses into political variables such as loss of support or votes, while bureaucrats measure them in terms of loss of bureaucratic budget or jobs. Because legislation on property usually affects many people, and explicitly calls into doubt the validity of all titles to all land, changes in the characteristics of real property right have been enacted cautiously and rarely; and have been reversed or cancelled. Furthermore, kings and governments have often diverted a narrow demand for new property laws to the acceptance of mitigative policies: subsidies, protective tariffs, regulations, or government spending.

5. A comparison The judicial and the legislative suppliers of changes in real property rights can be likened to hares and tortoises. Like a hare, the legislature has the constitutional power to leap forward, enacting large purposeful property reforms and revisions in land law. But coalitions and lobbies that follow this political route may find it simply ending, or even reversing, under pressure from opponents. On the other hand, demanders who seek help from the law courts may find that although litigation can give them a rapid remedy from a dispute concerning a particular parcel of land, the process thereafter proceeds at a tortoise's pace to harden this specific decision into general law. Further, because the courts do not set out to reform the social definitions of standard rights, they may easily be pushed off their original course.

To demanders the litigation and legislation routes are alternative suppliers. Indeed it is helpful to think of all potential suppliers as being in a competitive relationship with one another.

Part III. Why Fisheries' Rights Were Slow to Emerge

In this part I concentrate on fisheries rights.

We have seen that after Magna Carta, in the 13th century, common-law ocean and tidal fisheries rights could no longer be granted. Inland, however, the right of fishery did continue as a distinct interest, very similar to a profit, in the common law. The puzzle is why this situation remained the same for over 500 years. Why did not demanders take one of the four routes just surveyed, thus touching off processes that would eventually have added new characteristics to old standard interests?

A. Customary Fishing Rights

Why did not the forces of custom gradually shape fishing rights with new characteristics?

The key to the answer lies in the generalisation that changes in custom can change only rights that were customary. Common-law rights such as that of fishery, chiefly held under the common law as real property interests, could be changed only by royal statute or by reinterpretation by the royal courts.

There *were* important customary 'rules,' such as those for settling disputes about who owned an already captured or landed fish. (This would be an

article of personal property, rather than a category of real property.) Changing customs could change these customary rules, and would be accepted by the courts (Moore and Moore 1903). An interesting modern example is provided by whaling. Disputes had long arisen about which vessel owned a wounded whale, that which had first harpooned it, or that which ultimately captured it. Cases in the 19th century that came before the English and American courts were decided on the basis of evidence about custom.

The key to the answer lies in the fact that most medieval fishing rights, even those inland, were held as legal, not customary interests. Thus they were beyond the scope of customary processes to change. So far as we know, tidal and oceanic fisheries were even farther from the reach of custom (Ellickson 1988). Ellickson believes that the historical adaptation of these rules to changing whaling locations and species suggests that the group of whalers acted as a unit. In its customary rules the group was in effect seeking to minimise the sum of the cost of losing whales altogether and the costs of information, negotiations, enforcement and so on.

Research is necessary to determine the applicability of Ellickson's statement in the paragraph in the text to customary tenures in noncommon law jurisdictions, such as those in Micronesia. A useful short survey is contained in Johannes (1977). In most of his examples, the customary fishery tenures proposed for modernisation are indigenous but their change would come from 'government,' often applying western or colonial law concepts. Thus changes in customary interests are supplied by noncustomary sources.

B. Spontaneous and Violent Sources

Why did not independent and rebellious fishermen, disgusted with open-access problems, take the law into their own hands? One possible answer is that fishermen were less worried by scarcity than by other problems. This is discussed later.

Still, it is odd that there has been no well-known fishermen's revolt, to match the Peasants' Revolt. As we have seen, comparatively few inland people depended on fishing, and they seem to have had recourse to midnight poaching rather than to rebellion. Even tidal and ocean fishermen seem not to have been active, though friction between fleets, gears and ports must often have been greater. In more recent times, in the 19th and 20th centuries, it is not difficult to find examples of fishermen joining in action to close the fishery to outsiders. Examples that come to mind are those detailed by Libecap and Johnson (1983) concerning the shrimp fishery; by S.M. Jamieson concerning Canadian Japanese fishermen (see Scott 1962); and episodes involving different fleets or gears on the English coast.

Such combined action by fishermen has probably been more frequent in international relations, when fishermen of one nation seemed likely to be excluded by another nation. Histories of the three-mile limit, and of fisheries jurisdiction treaties, show that fisherman interests were identified with those of their national sovereigns. It is true that Hugo Grotius, in the early 17th century, established some general principles, leading to the doctrine of the freedom of the seas, and of the 'impossibility' of national sovereignty on the high seas beyond territorial waters. Notwithstanding Grotius, the naval wars between the European states did affect each state's fishermen's access to various grounds. The fishermen had enlisted military aid to gain fishing rights.

C The Disability of the Courts

Study of the history of property law shows that judicial process, described above, has not made much progress in adding to the characteristics of individual fishing rights.

As already conceded, in inland waters, medieval property law developed various kinds of private fishing right, and these have been subject to centuries of litigation. But these rights were rarely held in common. Furthermore, they conveyed only ownership in the right to catch fish, not to the swimming fish themselves. Thus they did not form an analogy or example towards which private saltwater fishing, or fish stock protection, could move.

Litigation and the common-law rights-evolving process work only when there is individual conflict or dissatisfaction with the interpretation of proprietary rights. From this conflict is derived the individual demand for litigative action. But when in ocean and tidal waters there was only a public right of fishing, there were no private rights to dispute. Seeking an increased amount of a characteristic, to add to nothing, leads to nothing. That is why, since Magna Carta, the common law process has not created private rights of fishing or of stock ownership, in salt water.

D. The Sluggish Performance of Government

In the three sections above I have shown that custom, force and courts did not make much impact on fisheries rights. I have suggested some reasons. Whatever the reasons, the outcome was that by the mid-19th century almost everyone occupied with fish-stock management had given up on these 'evolutionary' forces. As the controversies about salmon preservation and about the trawler question suggested, those who wanted improvement demanded that changes in fishery management should be obtained by statute law.

Government, however, was slow to respond. The world was familiar with open access pastures, rangelands, streams and wildlife. Government had rarely been called on to take action to end open access or its effects. Voters were attached to 'public right of fishing,' the right to hunt, commons, and the like. We may isolate two justifications for not ending open access, leaving well enough alone.

1. Open access had not created a 'problem.'

Until the 20th century, many of the main fleets did enjoy free or open access to the main fisheries. But most 19th century fishermen would not have been able to agree that they shared a 'problem' in the late-20th century sense.

Indeed, one source of coastal fisherman complaint was that some locals were *prevented* from enjoying open access. Some fisheries were exclusively reserved for outsiders. As just noted, diplomatic and legal battles were fought to define the limits of national jurisdiction. Wars and their peace treaties determined who might have rights to the best fishing grounds — and to the markets they supplied. The resulting fishing limits and markets were advantageous to some fishermen, 'problems' to others. But problems of territorial exclusion were not special to the fisheries nor the unique lot of fishermen, as Innis (1954) points out.

True, fishermen everywhere shared real difficulties, which were well-known and are well-described by 19th century novelists: Kipling in *Captains Courageous* and Melville in *Moby Dick*. Among these difficulties were risk of life and danger of injury, hard work, bad accommodation, poor food, isolated living conditions, and low pay and profit for all but a few. Thus overfishing was not yet recognised as a serious, or universal, 'problem.' It was known that certain inshore stocks had fallen and that, among international fisheries, some whales and seals were becoming scarce and that many races of Atlantic salmon had failed. But those were the days of the frontier. Both North Americans and Europeans expected wildlife, trees, and minerals to be removed, so that those who had exploited them must move on to something else.

Furthermore, for the really important demersal fish stocks of America, Europe and Asia, there had been no recognised biological failure. The great fishing grounds of the North Sea and the Grand Banks did not seem depleted. Alfred Marshall (1890), drawn into one aspect of the question, later wrote that the supply of fish could be likened to a perennial stream. He doubted that even the new steam trawlers had run into diminishing returns in sea fisheries. The sea is '. . . vast, and fish are very prolific; and some think that a practically unlimited supply can be drawn from the sea by man without appreciably affecting the numbers that remain there . . .' Marshall went on to mention that others argued that some fisheries had been overworked and did show a falling-off. He seems to have agreed with the optimistic position mentioned in the text. That there was possibly steam-trawler overfishing of some North Sea stocks was tentatively but officially recognised in Britain in 1893 (see Gordon 1954). Any boat could get a full hold if it tried long enough. What were perceived as the fisherman's information and transportation problems, quickly locate the stock and speed safely back to market, could not be appreciably solved by dealing with open access. Some fishermen would even gain by smaller stocks, smaller catches, and a higher price. Access to every tidal or ocean fishery was left open; anyone could take advantage of a 'public right of fishing.'

It was not until the end of the first world war that a general biological depletion problem was apprehended. The wartime relief of fishing pressure had led to a less than proportionate decline in total catches; and then, when full peacetime fishing was eventually resumed, to a striking increase in total catch. These events seemed to confirm hypotheses about declining catches per trip in the Pacific halibut fishery. Any stock of fish was known to be like a herd of livestock; biologists agreed that when a fishery was heavily harvested, the fish population was reduced both in numbers and in average age and size. These reductions were thought to explain its reduced catch per unit effort and capacity to produce an annual increment that could be steadily

harvested. Conversely, a drastic decline in fishing would allow the stock to grow, and to increase its own annual yield. Previously, the stocks had been impossible to observe or to estimate indirectly. Now the war and post-war evidence was that some stocks were becoming dangerously small.

Thus was slowly recognised a general biological challenge, soon to be described as the overfishing 'problem.' For later works about the earlier recognition of the stock problem, see Graham (1941) and Walford (1958). Fisheries biologists in increasing numbers sought evidence of its magnitudes, and strove to distinguish between natural fluctuations and fishing-induced shortages. Mathematical theories of greater sophistication were developed. Some rather ad hoc fishing laws and controls, at first limited to sport fishing and to salmon and a few other exposed commercial species, were imposed with a lavish but erratic hand. But these were isolated regulatory attempts to respond to unrelated overfishing complaints.

2. Fishermen were not collectively pressing for a solution.

Government supply decisions were based on political goals. For practical purposes, there was not yet a powerful fisheries bureaucracy: regulators had not appeared. Thus the pressure on the legislature was either directly from members' constituents, or from their party, cabinet and caucus. Here I consider only the pressure from fishermen constituents and lobbyists. Thus I omit the possible 'ideology' of the party or politicians, beyond the obvious, direct economic interest of constituents, for or against fishery reforms. For an excellent survey, see Kalt (1981).

Compared to agriculture, fishing hardly constituted a powerful political constituency. In the 19th century fishermen were rarely organised. Even in one country, they were divided in many ways; fishing with different gears, from different ports, in different grounds, on different coasts, at different times and different weather conditions. Some were owners and some were deck hands. Some rich and some poor. There were local natives and urban fishing and food companies. Thus their information differed, their goals differed, and their methods differed. To cap it all, captains and crews were regarded in law as individual entrepreneurs and sharemen, nominally separated by ownership and control from both the larger firms and the workers' unions.

Thus, although fishermen were skilled, reflective workers, often very articulate about their own problems, they had difficulty organising for any fisheries-oriented collective action. When they did, it is as Mancur Olson would predict: on the basis of other problems or values in common: race, location, family, etc. But neither these groupings nor political constituencies coincided with fish stock locations. Indeed some fishermen's organisations would not have survived were it not for their alliances with organised shore workers, often their mothers and wives. Among themselves they had all the usual problems of free-riding and arbitrary separation by administrative and jurisdictional boundaries.

E. Conclusion

In the 19th century, world fisheries were expanding. In some jurisdictions, fishermen grumbled: they were excluded by law or treaty from a favoured fishing place; markets were closed to them; workers were unreliable or wanted too large a share. Another grumble was that fish were getting harder to find and catch.

This final problem, where identified, inspired attempts to reduce excessive fishing pressure by exclusion. But the exclusivity characteristic was not supplied to enhance private fishing rights but those of whole fleets or nations. Customary sources did not exist. The courts of common law, in other areas a fruitful source of revision of property rights, were also impotent. They could not try actions concerning rights that, since Magna Carta, had scarcely existed. Thus the onus was placed on politicians to deal with overfishing, a problem which they did not fully recognise. The initial scientific evidence was weak. And fishermen-voters' political participation was both weak and contradictory. So government did not act to create ocean fishing rights, either territorial or personal. Instead, it gradually developed regimes of fisheries *regulation.*

Part IV. How Fisheries' Regulation Led to Fisheries' Property

A. The Parade of Fishing Regimes

Although fishermen were accustomed to rules and exclusions, few of these were designed to reduce fishing pressure. When governments did get to work on this problem, they entered on a sequence of kinds of regulation, modifying open access more and more.

1. Base-Case: Open-Access Consider first no-regulation, open-access regime of the Canadian and Newfoundland east-coast deep-sea demersal fishery, in mid 20th century, as it attracted attention in Gordon's (1954) original analysis. Vessels from Europe and America competed on the grounds. All had freedom of entry. First a hook (long-line) and later a net (trawler) technique was predominant. The best captains attracted the best crews in their ports, and got equipped with the best gear. The markets paid them a personal rent exceeding their potential in other employments. It was not surprising that skilled and established 'high-liners' preferred open-access fishing.

The economic effect of open-access fishing was illustrated by fishermen's incomes. In the 20th century the landed price of fish rose, and operating expenses fell. Each change attracted an increasing number of vessels and people to spend their time exploiting the basic fish stock and eventually catching a decreasing number and quality of fish. A few years later the highest incomes no longer reflected the crews' skills. Incomes were erratic. More and more was spent on fuel and speed, and reinvested in larger and faster vessels. The best fishermen made out better than the worst, but all incomes gradually slid down until equilibrium with the dole, or other poverty alternatives, was reached.

It is believed that all opportunities to cooperate, to coordinate seasons, to select fish by age, size and species, to invest in communal improvement of fishing runs or reproduction, or to informally recognise fishermen's priority, were ignored. Open-access fishing was nonsocial; it remained at the anarchistic hunter-gatherer stage of economic history, accompanying continual weakening and near-extinction of the biological base.

2. Regulating Open Access When government did intervene, it for the most part treated causes less than symptoms, using law-making resources lifted from other parts of the public sector.

For example, gear restrictions, apparently borrowed from angling and recreational hunting laws of the late 19th century, were applied to commercial shellfish digging and dredging, salmon harvesting and other essentially industrial processes; anything to protect the stocks from being swept up by voracious new technologies. Closed seasons, closed fishing grounds and numerical total quotas were evidently borrowed from the management of common lands and ranges.

Such regulatory devices probably saved some stocks from early near-extinction. But the fact of open access undermined the devices. The greater the success in enlarging the fishstocks, the more improved were vessels' profit potential. This lured additional people and vessels into fleets. Furthermore, good returns and good potentials induced owners of the older vessels to reequip with larger, speedier, and more effective boats. They could find the permitted quota sooner, bring it on board faster, hold more on board, and steam back to port earlier. Much of the potential income gains from regulation were spent on turning catching platforms into racing vessels: 'capital-stuffing' was the new teminology invented. Note the word 'much.' Not until entry was limited was it worthwhile for fishermen to invest *all* their profit in capital stuffing to keep ahead of other vessels. An early analysis of the wastes of regulation is found in Pearse (1979b). For a much earlier discussion of the economic wastes of open access and of inefficient regulation, see Herrington and Nesbit (1943).

3. Limited Access — Licencing Finally the regulatory authorities, who had already introduced licencing to help with administrative, revenue and statistical problems, began in the 1950s and 60s to limit access by limiting the number of licences issued (Beddington and Rettig 1983; Graham 1941; Hamlisch 1962). This has become the prevailing system at sea today. Limited licencing, however, does not appreciably change fishermen's behaviour, only their numbers.

With a limited number of licences, the value of being a fisherman could increase. Some fish increased in relative market value. New technologies cut crew, searching and fuel costs; the benefits no longer drew more fishermen but raised the potential incomes of those who remained. The value of being a licensee increased.

But limiting the number of licence holders could not end crowding, congestion, strategic fishing behaviour, racing, and capital stuffing. The real but unnecessary costs of the fishery have mounted almost as rapidly as the values of the licences. Notice the difference from farming. There is no loss of crop if a freehold farmer chooses a slower means of harvesting than his neighbours. But a licenced fisherman may not go his own way. To keep his share of a fixed total quota or catch he must still race to the ground, jostle and manoeuvre, be as swift and overpowering as the other vessels. Capital

stuffing and rent dissipation are greater than with open access, continuing the tendency to high costs that was first induced by excessive entry.

Indeed the catch is in no sense the fisherman's crop. It belongs to no-one. The licenced vessel is for hunting, not husbandry. Since limited-licencing can tolerate no tendency to cooperate or act constructively, it creates a situation where one would expect government regulation to be desired and accepted.

4. Limited Licencing with Regulation Indeed government regulation almost universally supplements limited licencing. One by one, restrictions on fishing limit harvesting with respect to time, place, vessel characteristics, gear characteristics, crew makeup, and fish length, weight, sex, age, and so forth (Turvey 1964).

Although regulations may work to the eventual advantage of each member of the fleet (in more valuable licences or larger catches), they work to the short-run loss of each vessel. A present-value incentive exists to evade and avoid the regulations, often aided by confederate vessels. This is the general opinion. For a closer look, see Bjorndal and Scott (1988). Consequently, regulation has thrust police-like enforcement and protective roles onto the regulators. For an extensive literature on enforcement and its costs, see Anderson (1977) and later papers.

Most decisions must be left to the government's administrators. Their job has not been made simple. Under limited licencing they are spared increasing numbers of vessels, only to be faced with increasingly large and powerful vessels. While it is difficult to generalise about this, rising fish prices constrained by a limited number of vessels, and unconstrained by any sort of territorial limit, have led to vastly increased individual fishing capacity every time regulators 'open' a fishery to the fleet. Dozens of powerful fishing vessels may be present to do in a few minutes what one or two vessels could harvest in a few days. Quite apart from the obvious social and economic waste of such excess investment in catching power, there is an administrative problem. Biological management becomes more difficult: small mistakes can waste a run or destroy a stock. Furthermore, selective fishing is difficult to organise and immature and bycatch fish are swept into the nets.

Even more important, as the value of fish increases, the profits of particular vessels or classes of vessels become increasingly vulnerable to administrative decisions. This vulnerability is also increased when the number of fishermen is reduced by limited licencing. And it is increased further when capital stuffing increases fisherman debt and dependence on the outcome of a declining number of fish openings. The ruin of each vessel hangs on the details of regulation. Each rule and each decision is scrutinised fiercely. This structure, and the ways in which it is monitored and enforced, inevitably affect different vessels differently, and so are regarded with great suspicion.

One result has been the elevation of fisheries administrators' status. After the turn of the century, their status became that of protector and policeman of all fishermen. Later, they acquired the additional role of referees, for the intervessel competition natural to open-access fishing is magnified into intense political conflict between groups of owners, divided by vessel size, fishing technique, gear, home port, or personal characteristics of the crews such as race, religion, or language. Because of all this, the higher administrators are finally elevated to the rank of lawgiver. Even on-the-spot regulators find they become less harassed and criticised than deferred to.

B. Regulation by Quotas

1. Costs and Benefits The idea of individual catch quotas is a fairly recent suggestion (Christy 1973; Pearse 1979b). In other papers I have described their emergence more fully, in (a) new fisheries, and (b) old fisheries; and speculated on how individual quotas seem an especially obvious development of regulation in internationally shared fisheries (Scott and Neher 1981). The government assigns to each vessel or owner an entitlement to land up to a given quantity of fish. This entitlement is a share of the total allowable catch (TAC) for the year or season, calculated in advance. Thus the word quota refers to either (a) the total TAC available to all fishermen; or (b) the quantity available to one vessel or enterprise. An intermediate sense is (c) the quantity out of the total TAC that is assigned to a stated portion of the fleet, such as the aboriginal quota, or the 'offshore quota' as understood on the Canadian Atlantic coast. There may be many stipulations, as to place, time, size of fish; or there may be almost none. Today we find quota regimes adopted or adapted in some of the sea fisheries of Iceland, Canada, Australia, New Zealand and Norway.

Enterprise quotas, especially those assigned to a processing plant, can be regarded as essentially an assemblage of numerous individual quotas. There were early examples everywhere in the salmon industry; for example the assignment of the entire catch of one river or bay to a single processing company in British Columbia canning in the 1900s (Gregory and Barnes 1939). Gertenbach (1973) refers to pilchard enterprise quotas dating from 1940 or earlier. The modern Canadian offshore cod quotas are assigned to large corporations. Japan also began to rely on high-seas enterprise quotas after World War II, according to Comitini and Huang (1971). Enterprise quotas can also be regarded as fractions of a national quota. Presumably the offshore distant water nations, negotiating licences or other catching privileges for their flag vessels, break their acquired national rights into individual enterprise quotas.

The chief economic advantage of an individual quota regime is in the reduction of fishing costs. Because each vessel is in effect guaranteed that its quota of fish will remain there, swimming, waiting to be caught, the vessel need not race other vessels. It can take its quota in any way it chooses. It follows also that quotas result in lower costs than fishery taxes or royalties. This is a different point than that found in the economic literature, beginning with Moloney and Pearse (1979) who argue that with a *given* fleet cost curve, a tax on the catch can be found that will lead to the same catch and cost of catching it as a set of individual quotas. But the cost-advantage outlined in the text cannot be obtained by a tax: the fleet on a quota regime will have a *lower* cost curve than a taxed fleet bringing in the same catch. The chief biological advantage is that the TAC can be set so as to allow the fishstock to grow, migrate, become more mature, or whatever is the biological goal.

2. Quotas are Costly Means of Regulation

Quotas as so far described are simply a development of limited licencing plus regulation of catching methods. They reduce racing behaviour and investment and the need for gear regulation.

The reduction of racing costs brought about by quotas depends on how accurately government predicts the TAC. When the predicted TAC and closing date of migratory and seasonal fisheries remains uncertain, quota-owning fishermen will seek to land their catch early. The greater their uncertainty, the more they will invest in racing behaviour, discounting later catches heavily and using heavy-duty gears. This increases catching costs, congestion of fishing grounds, and widens in-year and between-year variations in landings and marketings. Such results can be prevented by additional government regulations illustrating how *uncertainty* can lead to a failure of private quotas to replace government determination of allocation and distribution in harvesting.

In a quota regime, very little qualitative regulation of equipment or effort is required for the short-run purpose of limiting the catch. In principle, quota holders may use any old gear they choose. Because the *catch* is the unit of entitlement, the authorities must concern themselves with gear and net-type only in connection with the long-run management of the stock, with respect to size, sex, and so on.

However, quotas as so far described remain a part of the regulatory system, scarcely shifting the fishery in the direction of private management and planning. Government administration continues to be almost as necessary as in the earlier regimes. The following essential, costly roles for government should be noted.

First, a quota system cannot dispense with government as a means of determining each year's TAC.

Second, holding quotas does not in itself allow fishermen to take over other aspects of long-run management of the fish stock and its predators and preys; nor of protecting its environment.

Third, a quota regime alone is not sufficient to prevent fishermen from wasting bycatches (see below).

Fourth, a quota regime requires government enforcement. Indeed, it may well require enforcement and administration spending higher than in the licencing-plus-regulation regime, so that many think that poaching is the Achilles' heel of a quota regime. For example, both Pearse (1979a,b) and Copes (1986) have warned of the excessive enforcement costs of quotas when sales and runs are unpredictable. These include both general expenses and the detailed checking of log books, verifying all fish marketings and quota exchanges on land and sea, and possible extra observers. The failure of the Bay of Fundy herring quota system to supplant government is discussed in Campbell (1981) and Crouter (1984). Reminding us that a licence system with regulation can be cheaply enforced — by simply assuring that no vessel is on the ground when the fishery is closed — they point out that there are no such cheap automatic checks under a quota

regime. However, the very strength of an individual quota regime may be that it creates individual and group incentives for self-enforcement. The ownership of an individual catch quota may make a captain less sympathetic to poachers and so less likely to poach or cheat himself. This may involve refusing to stand by while his friends exceed their quotas.

In part, whether poaching or self-enforcement are the dominant behaviours in a particular fishery is a question of fact. The facts for some new New Zealand and Australian fisheries, and even for some older Icelandic and Canadian quota fisheries are that government must enforce the system, but that the costs are not excessive compared to alternative regimes. In part, it has to do with the nature of property (see below).

C. Conclusion

Consideration of these four costly governmental fishing-regulation functions under a quota regime tells us that this regime is not yet a private property-rights system. It is able to meet the biological challenge of overfishing that led to the 19th century initiation of regulatory regimes. And, in quotas, these regimes promise to cut many of the wasteful costs of fishing associated with limited entry without limited effort. But a simple quota regime gives very little more scope for fisherman initiative and choice than the regulatory regimes it has succeeded. It deserves to be regarded as no more than a modest improvement on previous regulatory regimes.

Part V. Quotas and the Characteristics of a Property Right

In Part II above I referred to the characteristics of interests in land and natural resources that make them 'property.' In this final part it is shown how ITQs combine more of various characteristics than quotas alone, and how a further increase in these characteristics can make the ITQ a building-block for fisherman-managed fish stocks.

A. Adding Characteristics to the Catch Quota

To become a right-and-market regime, quotas need more of the characteristics of real property rights. This can be seen by considering again the advantages of four of the characteristics briefly listed in Part II.

Exclusivity As already suggested, this is the chief advantage of a quota regime. It gives the fisherman an exclusive right to his fraction of the TAC and so an incentive to set his own fishing pace. There is much reduced reward to racing behaviour, and to capital stuffing.

However, the quota gives the fisherman no rights over the swimming fish stock — this is discussed below.

Transferability and Divisibility Quotas need not be transferable, and some of their advocates have recommended that they be kept under strict government control by: (a) being auctioned periodically; (b) being usable only by the party to whom issued or by a limited class to which that party belongs (Economic Council of Canada 1980); and (c) being indivisible. However, as the name Individual Transferable Quota suggests, in almost all quota schemes the units *have* been made marketable. This creates not only the general marketability gains referred to earlier, but more.

The first added gain arises from reducing the burden of uncertainty. Transferability permits employing the marketplace to assist in reconciling fixed quotas with an uncertain, variable TAC. Here is one version. The quota fisherman starts the fishing season with a quota entitling him to a specific tonnage. Errors are to be expected: towards the end of the season there will be an official announcement of a surplus to be added to or a drawback subtracted from his quota. Uncertainty about this is unavoidable, but transferability reduces its cost. The fisherman can stop fishing when he chooses; he may enter the quota market to buy and sell (or lend or borrow) parts of other fishermen's quotas. In other words, tradeability makes it possible for the whole fleet to pool the TAC uncertainty.

A second added gain from marketability arises from easing the bycatch problem. Even a nontransferable quota regime encourages fishermen as a group to work out how to land no more than the TACs of each species. Transferability and divisibility make it easier, by allowing market determination of a value for rights to land each species. By acquiring more of quotas in species A, some fishermen can specialise in that species. Others can try for mixed catches. Quotas and/or fish markets later reconcile their respective catches with the needed quota holdings.

Duration Quotas can be issued for any period. However, their capacity to allow holders to plan investment of their time and resources is lost unless

they are issued for a number of seasons together. Long duration (and/or easy renewal) appears to be already the rule in most quota regimes.

B. Adding Characteristics to ITQs, the Total Fish Stock and Communal Ownership

Consideration of characteristics and rights suggests an important conclusion: an individual *catch* quota regime is only the first stage in the development of management from government licencing to private rights. This evolution can be expected to continue until the owner has a share not only in management decisions regarding the catch *but also in management of the biomass and its environment*. Such an evolution can be seen in two further stages.

1. Joint Harvest Activities The ownership of individual catch quotas gives fishermen an independent position from which they can form owners' alliances or committees. As harvesters, they can organise to coordinate searching activity and reduce wasteful racing; jointly negotiate with regulators over TACs, bycatches, openings, quota markets, enforcement records and other day-to-day issues; and mobilise self-enforcement to reduce poaching. If the transactions costs of a trade in quotas for bycatches are too high, internal penalties and fines may be substituted. Stevenson (forthcoming) reports that the Swiss alpine pasture communes impose fines on their own members for overgrazing, and pay bonuses for approved behaviour. Stevenson regards this system as having lower information and transacting costs than a trade in quotas alone.

That fishermen will work together in these ways when they have an individual sense of exclusivity of the harvest is not improbable (Johannes 1987; Pollnac 1984). Other commons are managed by their user/owners. Recent literature describes the control of commons of pasture and open fields not only in the middle ages, but in developed and developing countries today.

That community social organisation can be mobilised to take over the management of village and local fishing places is the aim of the TURF concept, fostered by FAO (Christy 1982). This, it is hoped, will replace administrative centralisation, improve rule-making and rule-compliance, and reduce friction between adjoining communities by encouraging agreement on TURF boundaries. It goes without saying that the TURF idea is not in conflict with individual quotas. A TURF could be formed to acquire the whole TAC for an entire community, farming out individual quotas to its members, as with medieval commons. On the other hand, ITQs may be useful wherever a defined community has no particular customary or historic linkage to the neighbouring fish stock. Such communities may find it easier to form a TURF if initially each member adds his or her individual quantitative right to a pool. In such a case the newly formed TURF or community may decide either to hand out quantitative quotas or to rotate locational or territorial fishing rights (for there is no doubt that the allotment of fishing places is the easier to enforce). In brief, a fishing community or TURF may be started with ITQs, or it may use them after the TURF has been started by other means. For a discussion of starting at the community level, see Ostrom (1988). She relies on papers by Fikret Berkes, dealing with both Turkish and Canadian fisheries.

Outsiders or even foreign fishermen can be accommodated in a local fishery or TURF by issuing *individual* or what have been called enterprise quotas to them. This explicitly quantitative approach has in many cases advantages over the prevailing indirect 'access' licencing approach (as current in the PNG–Japan arrangement as discussed in Doulman 1987). It may be predicted to become a more common tenure for foreign vessels in the future (although this prediction was first made in the early 1970s, and did not materialise). The advantages are analogous to the 'supervisory' advantages to the landlord faced with deciding between working his own land with wage labour, or going over to some form of share or cash tenancy or profit-a-prendre. In the fishery, both as a means of controlling revenue and as a means of allocating the safe annual harvest between local and foreign fleets, some form of quantitative tenure is necessary.

2. Joint Long-Run Stock Management What is now regarded as an administrative quota system could become a stage in the process not merely of regulating the catch but of integrating sole-ownership harvesting control with stock protection and enhancement. Quota-holders, collectively, will naturally take a more long-run interest in the betterment of 'their' fish stock or stocks, when their individual rights have duration, exclusivity and transferability.

Thus an individual quota may become something like a share in a growing land enterprise. Investments can be undertaken. Naturally, these will

be primarily investments in stock: long-run management to improve numbers, local stocks, and size and age composition. But quota-holders can also jointly make other investments. They may jointly or with neighbours undertake to provide search, enforcement and protection personnel and vessels, and an electronic quota market and clearinghouse. And they may contract with local governments and landowners concerning pollution and habitat improvement activities, and possibilities of investing in land or improvements themselves.

Opportunities to assemble individual rights and powers to cooperate in doing some of these things exist already. But the fisheries rights literature has failed to see individual rights as the nuclei of larger sole-ownership corporations or collectives.

My point here is that the ITQ regime is not yet a great advance in whatever trend there is towards individual fishery interests. It offers fewer characteristics than many of the surviving inland territorial fishing rights still to be found under the English common law. It does not even offer an escape from the doctrine that wild fish are incapable of ownership until caught, but offers fishermen less decision-making power over the natural resource than that of some medieval graziers who could play a role in their village court or meeting.

What is missing is the possession of the right, or responsibility, to *manage* both the harvest and the stock itself, an idea I have urged for some years (Scott 1955, 1957). To appreciate what is missing recall the rights of ownership as set out for all students of property law. The characteristics that contribute to 'ownership' of land or a resource, he is told, convey three powers: to enjoy the profit or yield; to sell or alienate the asset; and to manage the asset. Any fishing right such as a catch quota, that has the characteristic 'quality of title' will provide the first of these powers. A catch quota with the characteristic 'transferability' can also be expected to provide a fisherman with the second power, to sell or rent his right. But the catch quota system does not provide the third power: the right, or responsibility, of management of either the fish stock or its environment. This is left privately unassigned.

Of course, as I have argued in earlier papers, the political reality is that owning a quota should make it easier and cheaper to act collectively, either in bringing political pressure to bear on government administrators, or in collectively administering and coordinating their private rights. As a pressure group, quota-owning fishermen may be consulted regularly; and may have success in lobbying for particular management policies. I argued in a Brown/Crutchfield volume on marine research that rights to the fishery may make possible more efficient, price-oriented allocation of the ocean between fishing and other users, such as the offshore oil industry. Although success in relying on this political route *could* result from the introduction of a system of quotas, it may not, for the ideas behind the new quota regimes do not include private or political participation in management, or even direction of the managers. The regulator-managers are not seen as the fishermen's agents. They are free within the constraints of the constitution and the political system to diverge from the fishery-management plans that would benefit the quota-holders.

Fishermen's recognition of this may explain why they are not politically active to obtain ITQ regimes in old fisheries. As a mere extension of the present system of regulation, subject to government management plans and priorities, these regimes do not promise that the interested parties may deal with the long-run problems of common property, such as investment in the stock or in complementary improvements and enhancements, but only that the parties must continue to have these problems handled (or neglected) on their behalf.

In this respect the economic literature on fisheries quotas simply fails to wrestle with the individual-collective interaction encountered in the managing of other common-property resources. I can mention several of these. *First, the open-field system.* Economists admit that whatever efficiency it possessed arose from the control of fallowing and seasonal grazing by those who owned, as copyholders, limited private rights to plant and harvest their own crops. *Second, the unit operation of oil fields.* Research has revealed the owners' trade-offs between field-wide control over the total rate of extraction, and secondary recovery, and strictly individual well management. *Third, water pollution.* Even in the economic literature on individual emission rights are suggestions that rights holders can both adjust to the market price of rights and participate in the collective management of the receptor. *Finally, water rights.* The economic literature contains many discussions of the reconciliation of unified watershed or aquifer management with a system of individual, marketable appropriative rights. One approach

indeed is for the control of each water-supply (distribution and storage) corporation to be shared among and limited to those who own individual appropriative rights to the water resource. These examples indicate economists' awareness that individual quotas to a collective resource can be more than short-term profits-a-prendre. (For pastures, see forthcoming works by Robert Allen on the management of the enclosed English commons and by Glenn Stevenson on Swiss alpine pastures. For oilfields, see analytical papers by Libecap and Wiggins (1984). For pollution rights, see Dales (1968). For water rights, see Cuzan (1983); on p. 43 Cuzan quotes Elwood Mead, 1903, to the effect that a good surface water system needed the ownership of distribution companies to be divided in proportion to the state-granted water rights of the individual shareholders.)

C. A Note on ITQs and Foreign Distant Water Fisheries

The purpose of this section is to open discussion of the possible functions of ITQs in the negotiated arrangements between coastal or island states, and foreign distant water fleets. To do this I divide nations such as the Pacific Islands into three categories. All of them have fisheries exploited by foreign fleets. The two differences among them are as follows. In the first two there are only foreign fleets, while in the third there is a small but possibly growing domestic or national fishing fleet. And, in states in the first category, total fishing so far is small in relation to the size and recuperative powers of the fished stock, but in the second and third categories fishing is so vigorous that it threatens the stock. I will consider whether an ITQ regime, adopted by these categories of states, would assist in the performance of three functions: keep the total catch within the estimated TAC; obtain information about the stock, for the setting of future TACs and for other scientific purposes; and serve as a revenue collecting mechanism.

In states in the first category, in the short run, there is no scarcity. In such circumstances, a coastal or island state has little need of limiting either the number of vessels or the catch per vessel. Then one reason for its adopting ITQs will not exist. Of course, we should expect the foreigners to somehow control the size of their own fleet. If a foreign government is negotiating on behalf of its fishing industry, it can be regarded as issuing licences authorising vessels to participate, or enterprise quotas, dividing the foreign catch among companies or vessels. What of the other two — biological monitoring and revenue? The second purpose is, when fish are plentiful, probably not regarded as urgent. The revenue-collection purpose may be more cheaply served by putting a price on the presence of a licenced foreign fishing vessel fleet than by issuing ITQs. Thus, in the short-run at least, we would not expect to observe an ITQ regime in such states.

In states in the second category, there is genuine concern about the impact of current fishing on the coastal or EEZ fish stock. When this is the case the administration becomes anxious to prevent overfishing, and so considers various economic methods of reducing effort, including ITQs. And it places more importance on statistical measurement of the catch and catch per unit of effort. At the same time, it seeks revenue. For all these reasons we may expect to see more states in this category than in the first, granting quantitative rights to foreign fleets or enterprises, or individual vessels (even though surveillance and enforcement are costly compared to a vessel-licencing regime).

In a third category group of states, the catch is divided between foreign nations and local fishermen. What is more important, it may be expected, or planned, that the share of locally based fishing enterprises or individual vessels will increase in the future. Clearly, here, the state will carry out the first function in such a way as to leave scope for an expanding local industry: imposing quantitative controls on all participants. Indeed, it is difficult to see how a state could assist a locally based fishing industry, and still obtain revenue from foreign vessels, without some sort of ITQ regime to give secure catches to both 'fleets.' Probably the introduction of local vessels would be handled by the introduction of nontransferable local individual quotas (i.e. not transferable to foreign vessels or enterprises).

The argument thus far, considering island and coastal state fisheries in three categories, can be regarded as considering three stages of development. It suggests that ITQ regimes will be introduced as fish stocks become scarce, and as local fishermen become ready to participate in what has so far been a foreign fishery. The reader will observe that this prediction does not flow from the main argument of the paper: that the ITQ may evolve as a distinct class of property right. The prediction here may be independent of whether or not the ITQ remains as

an instrument of government licencing. If it does so remain, we would find ourselves back in the Middle Ages, observing fisheries controlled by government for the raising of revenue from wealthy outside fishermen. Long-run stock management would remain a government function.

Perhaps, this time, the whole dreary, disappointing and costly history of depletion, regulation, limited licencing, capital stuffing, regulatory evasion, and the belated introduction of ITQs in a few EEZs need not be repeated (Christy and Scott 1965). All fishermen, foreign or not, may participate in catch and stock planning, protection and management. This is a fairly new subject, requiring extensive research into institutional alternatives.

D. Conclusion

The theme of this paper has been that ITQs are on the way to emerging as a distinct class of interest in a natural resource. They did not emerge from the orthodox sources — the courts or special government legislation — but from the process of tinkering with unsatisfactory regulatory licencing. Because of this origin, they may not develop as full-blown property rights unless those responsible for regulatory regimes prepare to divest themselves of their controls over fishing and fishermen.

At the present time they lack some of the most valuable and essential 'characteristics' of other property rights, including what is needed to be pooled or assembled for the collective management of land or natural resources.

In this Part, I have attempted to illustrate how, by analogy with other kinds of rights, they can be extended and strengthened. Fishery economists have not yet accepted these lessons about the possibilities of further development of ITQs, lessons that lie at the very heart of our economic institutions and constraints. In the fisheries literature, a quota is a quota, an instrument of government control. It is not regarded as an interest that gives evidence of possessing and owning, and of power to choose, innovate and economise. Consequently, emphasis has been too much on the problems of coping with individual behaviour — such as enforcement costs — and not enough on the problems of reconciling, permitting and encouraging joint action and common consent.

Acknowledgments

This paper is developed from Scott (1986) and from papers delivered in Reykjavik to the NATO conference on rights-based fishing in June 1988, and to the APPAM conference in Seattle in January 1989. Versions of the former are to be published in Marine Policy in 1989 and in a conference volume also due in 1989. For research and discussions on aspects of these, I am indebted to Bette Bono, Ragnar Arnason, Harry Campbell, Rognvaldur Hannesson, Nina Molett, P.A. Neher, Gordon Munro, Peter Pearse, Gary Libecap, and others named in Scott (1986).

References

Anderson, L.G. 1977. Economics of Fisheries Management, Baltimore, Johns Hopkins Press.

Beddington, J.R., and Rettig, R.B.1983. Approaches to the Regulation of Fishing Effort. FAO Tech. 243.

Bjorndal, T. and Scott, A. 1988. Does the Prisoners' Dilemma Apply to Fisheries? UBC Research Paper.

Campbell, H.F. 1981. The Bay of Fundy Herring Fishery, Technical Report No. 20. Ottawa, Economic Council of Canada.

Christy, F.T. Jr. 1973. Fisherman Quotas: A Tentative Suggestion for Domestic Management, Occasional Paper 19. Rhode Island: Law of the Sea Institute.

1982. Territorial Use Rights in Marine Fisheries: Definitions and Conditions, FAO Fisheries Technical Paper 227, FIPP/T227, Rome, FAO.

Christy, F.T. Jr. and Scott, A. 1965. The Common Wealth in Ocean Fisheries. Baltimore, Johns Hopkins Press.

Comitini, S. and Huang, D.S. 1971. Licensing and Efficiency, An Empirical Study of the Japanese Tuna Fishing Industry, Malayan Economic Review, 16, 76-83.

Copes, P. 1986. A Critical Review of the Individual Quota as a Device in Fisheries Management. Land Economics. 62(3), 278-291.

Crouter, R.A. 1984. Quotas for the Herring Fishery of the Bay of Fundy. FAO F.R. 289, Suppl. 3.

Cuzan, A.G. 1983. Appropriators versus Expropriators: The Political Economy of Water in the West. In Anderson, T.L., ed., Water Rights. San Francisco, Pacific Institute for Public Policy Research.

Dales, J.H. 1968. Pollution, Property and Prices. Toronto, University of Toronto Press.

Doulman, D.J. 1987. Licensing Tuna . . . in PNG. Marine Policy, 11, 16-28.

Demsetz, H. 1967. Towards a Theory of Property Rights. American Economic Review 57, 347-359.

Ellickson, R.C. 1988. A Hypothesis of Wealth-Maximising Norms: Evidence from the Whaling Industry. Stanford University Law School, Olin Program WP # 43.

Economic Council of Canada. 1980 Newfoundland. From Dependency to Self-Reliance, Ottawa, Supplies and Services Canada.

Gertenbach, L.P.D. 1973. Licence Limitation . . . the South African System. Journal of the Fisheries Research Board of Canada, 30,12, 2077-2084.

Gordon, H.S. 1954. The Economic Theory of a Common Property Resource: The Fishery. Journal of Political Economy 62, 124-142.

Graham, M. 1941. The Fish Gate, London, Methuen.

Gregory, H.E., and Barnes, L. 1939. North Pacific Fisheries, New York. Institute of Pacific Relations.

Hamlisch, R. 1962. Economic Effects of Fishery Regulation, Report 45 of 1961 FAO Expert Meeting, Ottawa. Rome, FAO.

Hatcher, John. 1954. Rural Economy and Society in the Duchy of Cornwall, 1300–1500. Cambridge: Cambridge University Press.

Herrington, W.C. and Nesbit, R.A. 1943. Fishery Management, (papers at Fish and Wildlife Conference, Baltimore) U.S. Department of Interior. Special Scientific Report 18, Chicago. mimeo.

Innis, H.A. 1954. The Cod Fisheries: The History of an International Economy. Toronto, University of Toronto Press.

Johannes, R.E. 1977. Traditional Law of the Sea in Micronesia. Micronesia, 13(2), 121–127.

1987. Primitive Myth. Letter to Nature, 325, 5 Feb. 478.

Kalt, J.P. 1981. The economics and politics of oil price regulation. Cambridge, Mass. USA. The MIT Press. Chap. 6.

Libecap, G.D. and Johnson, R. 1983. The Louisiana Shrimp Fisheries. American Economic Review, 73.

Libecap, G.D. and Wiggins, S.N. 1984. Contractual Responses to the Common Pool: Prorationing of Crude Oil Production. American Economic Review, 74(1), 97–108.

McGrady, J. 1975. The Navigability Concept in the Civil and the Common Law. Florida State University Law Review 3: 513.

Marshall, Alfred. 1890. Principles of Economics. 8th ed. (1920). London: Macmillan.

Miles, E., Peally, R. and Stokes R., ed. 1986. Natural Resources Economics and Policy Implications: Essays in Honour of James Crutchfield. Seattle, University of Washington Press.

Moloney, D.G. and Pearse, P.H. 1979. Quantitative Rights as an Instrument for Regulating Commercial Fisheries. Journal of the Fisheries Research Board of Canada 36, 859–866.

Moore, S.A. and Moore, H.S. 1903. The History and Law of Fisheries. London, Stevens and Haynes.

Ostrom, E. 1988. Institutional arrangements and the commons dilemma, Chapter 4 in Ostrom, V., et al, ed., 1988.

Ostrom, V. et al. ed. 1988. Rethinking Institutional Analysis and Development. San Francisco, International Center for Economic Growth.

Pearse, P.H., ed. 1979a. Symposium on Policies for Economic Rationalization of Commercial Fisheries. Journal of the Fisheries Research Board of Canada, 36.

1979b. Property Rights and the Regulation of Commercial Fisheries. Vancouver, University of British Columbia, Economics Dept. Resources Paper No. 42.

Pollnac, R.B. 1984. Investigating Traditional Use Rights Among Fishermen. In Ruddle, K. and Akimichi, T., ed., Maritime Institutions in the Western Pacific, Senri Studies 17: 285–300. Osaka, National Museum of Ethnology.

Postan, M.M. 1972. The Medieval Economy and Society. London, Penguin.

Scott, A. 1955. The Fishery: The Objectives of Sole Ownership. Journal of Political Economy, 63, 116–124.

1957. Optimal Utilization and Control of Fisheries. In Turvey, Ralph and Wiseman, Jack (ed.), The Economics of Fisheries. Rome, FAO.

1962. Economic Effects of Regulating Fisheries, in Hamlisch, R., ed.

1986. Catch Quotas and Shares in the Fishstock as Property Rights, Chapter 4 of Miles, E., Pealy, R., and Stokes, R., ed., Natural Resources Economics and Policy Applications — Essays in Honor of James A. Crutchfield, Seattle, University of Washington Press, 61–96.

Scott, A. and Neher, P.A. 1981. The Public Regulation of Commercial Fisheries in Canada. Ottawa: Economic Council of Canada, and Dept. of Supplies and Services. (See also accompanying studies by inter alia, Bushuk, D., Campbell, H., Crutchfield, J., Fraser, A., McCorqudale, S., MacDonald, J., Munro, G.R., Tugwell, M. and Wilen, J. on lobsters, herring, halibut, cod, and roe herring.)

Stevenson, G.G. (forthcoming). The Swiss Grazing Commons, (based on Ph.D. dissertation, University of Wisconsin) New York, Cambridge University Press.

Turvey, R. 1964. Optimization and Suboptimization in Fishery Regulation. American Economic Review 54: 64–76.

Walford, L. 1958. Living Resources of the Sea, New York, Ronald Press.

Traditional Sole Property Rights and Modern Inshore Fisheries Management in the Pacific Basin

Kenneth Ruddle[1]

Abstract

Among management schemes for coastal fisheries, those based on sole ownership concepts have been relatively little studied. The concept has been applied most widely in the Pacific Basin, where it ranges from sole quasi-ownership of specific localised sites, or other factors, by individuals, families, clans, or other small social groups, to the complex, tradition-based modern state legal system of Japan. This paper examines the main characteristics of fishing territories, fishing rights and controls in sole ownership systems of fisheries management in parts of the Pacific Basin. An outline agenda of research on sole property rights-based fishery management systems is provided.

Introduction

MARINE fisheries in Western societies are perhaps the last major resource to have been exploited under open access regimes, which, it is commonly agreed, is the cause of excess effort, the principal and least tractable of marine fisheries problems. Generally, too, it is accepted that the replacement of such regimes by systems of controlled access and associated rights could either eliminate or ameliorate excess effort. Limited access and associated rights systems, which assign fish harvesting rights to selected individuals, who then receive all or part of the economic rent created by the reduction in effort, have been the form of management most widely implemented, owing principally to their political acceptability and resultant ease of implementation, and as a means of raising incomes in fishing communities (Keen 1983).

At the opposite end of the spectrum are systems of specific property rights through sole ownership of resources. The principal basic precept is that full sole ownership must be invested in a managing agency which owns the biological productivity of the habitat, the cropped species, and the rights to control harvesting and marketing (Keen 1983). But the potential of sole ownership as a fisheries management tool has been relatively little examined, although its efficacy has been recognised, at least in conventional economic terms (Gordon 1954; Scott 1955; Crutchfield and Pontecorvo 1969; Copes 1972; Keen 1983, 1988). By contrast, Wilson (1982) asserted that there was no evidence that property rights schemes were clearly superior to others and socially economical, given that the costs of management should not exceed the social opportunity cost of the problem that led to the implementation of rules. Clearly, given the dearth of in-depth studies of sole ownership management systems of marine fisheries, these various perspectives remain assertions in want of verification.

[1] National Museum of Ethnology, Senri Expo Park, Suita, Osaka 565, Japan.

The neglect to pursue an in-depth examination of the potential of sole ownership rights in fisheries is ironic since Gordon (1954), in a seminal paper which so stimulated inquiry into other forms of fisheries management, observed that, other than through luck, only fishermen who participate in a fishery '... that is put under a form of social control that turns the open resource into property rights' become rich. Gordon (1954) further observed that among 'primitive' (*sic*) cultures 'property rights in some form predominate by far, and, most important, their existence may be easily explained in terms of the necessity for orderly exploitation and conservation of the resource. Environmental conditions make necessary some vehicle which will prevent the resource of the community at large from being destroyed by excessive exploitation. Private or group land tenure accomplishes this end in an easily understandable fashion.' He then exemplified his contention with reference to land tenure among the Trobriand islanders of Papua New Guinea, based on Malinowski (1935).

Traditional Management Systems

Although traditional systems of fisheries rights have been documented for coastal waters and estuarine areas on all continents, for most localities the tenurial relationship of small-scale fishermen to resource areas and resources is not well known. There are few comprehensive accounts of the functioning of systems of sea tenure and associated institutions, and much of the earlier research in the region has been characterised by a lack of appreciation of the embeddedness within larger socioeconomic systems of local traditional forms of fisheries management (Akimichi and Ruddle 1984; Durrenberger and Palsson 1987). In the Pacific Basin such concepts range from the sole quasi-ownership of specific localised sites by individuals, families, clans, or other small social groups, to the complex state legal system of Japan. Use rights may be to specific locations, during particular seasons, to specific species, or for a specific gear type. Other forms of sea tenure are less concrete and may include such concepts as exclusion mechanisms, first-comer's rights, and the like.

It is not intended here to assume unreservedly that traditional fisheries management systems in the Pacific are or were necessarily effective in every instance. Such an assumption is precluded by both the quality of the bulk of the available literature and by the absence of detailed evaluations of individual systems. But as McGoodwin (1984) has observed, 'good studies show that when fishermen have property rights there is less tendency to overexploit marine resources,' and conversely, as in Oceania, for example, stocks are commonly overexploited where traditional sole property systems have been replaced by open access. Johannes (1978) demonstrates that whereas there are in the Pacific Basin a number of documented instances of unrestrained harvesting leading to serious resource depletion, these were the exception, and that wise resource management was the prevailing pattern throughout pre-contact Oceania.

This paper summarises the territorial and rights bases of traditional inshore fishing in the Pacific Basin, and suggests some basic topics for research on systems of sea tenure.

Principal Characteristics of Sea Territories and Use Rights in Oceania

In the Pacific Basin fisheries have commonly been managed traditionally by systems of tenure and access rights. In this region traditional sea tenure and the exercise of fisheries rights closely reflect social organisation and local power structure (Sudo 1984; Ruddle 1989).

(1) Resource Use Territories are Defined

The sea territory of a social group is usually defined with reference to proximity to its settlement(s) and with reference to lateral and seawards boundaries.

As a general principle, on most islands the exclusive fishing territory of a community was in the adjacent marine waters, within the reef. In Palau (Johannes 1981), Pohnpei (Fischer 1958), and Yap (Labby 1976), for example, the adjacent waters of the village clusters (municipality) were reserved for the exclusive use of a particular village. In the Marshalls a lineage held exclusive rights to waters adjacent to its land. In most places islanders maintain exclusive rights to all known adjacent submerged reefs, which are named and owned exclusively by particular families, clans, municipalities, islands, groups of islands or atolls, as the local social organisation dictates. Seawards of the reefs the degree of exclusiveness of rights gradually declines (Nakayama and Ramp 1974).

Lateral Boundaries In general, the lateral or coastwise boundaries of a community's exclusive fishing area were a seawards extension of the

community's terrestrial boundaries. Variants on this general principle of direct seawards extension of the terrestrial boundaries occurred where some distinctive physical feature of the reef, such as a passage or channel, was used to mark a lateral boundary, as in Yap (Lingenfelter 1975). These lateral boundaries were sometimes marked artificially. On Pohnpei, for example, piles of coral were erected as boundary markers (Fischer 1958).

Seawards Boundaries The sea rights in the waters adjacent to a particular island may be divided conceptually into an inner and an outer zone. Usually an island or atoll maintains either the exclusive or the primary rights to the nearshore waters immediately around it. In the outer zone the island or atoll will usually have dominant but not exclusive rights.

Although the criteria for defining the inner zone are not uniform, in Oceania the exclusive fishing territory of a community generally extends just seawards of the outer reef slope, e.g. Palau (Johannes 1981). But local variations to this general principle occur. Water depth is the determining factor in the Marshall Islands; the point where deep sea species replace reef organisms is the dividing zone in the Central Carolines (Akimichi 1986); the outer edge of the reef, the distance to the horizon, the limit of bottom visibility, and isolated patch reefs are criteria used by different ethnic groups in the Solomon Islands (Baines 1985); and the distance from the shore at which diving for fish or shells is possible is the criterion applied in Vanuatu (Taurakoto 1984). Criteria for defining the outer zone also vary considerably within the Pacific region. In Palau, some communities claimed that their fishing territory coincided with the seaward range of homing seabirds inhabiting Palau (Johannes 1981). In the Central Carolines the strength of rights within the outer zone extends seawards towards a neighboring island, to a point at which that island's rights become primary.

(2) Resource Exploitation is Governed by Use Rights

Throughout Oceania rights to exploit the fisheries resources of reefs are subject to various degrees of exclusiveness depending on their relationship to social organisation and the culture of the communities controlling them. Most commonly, traditional fisheries rights apply to areas (Baines et al. n.d.). Superimposed on sea area rights may be claims held by individuals or groups to a particular species or to a particular fishing technology.

Customary systems rights to marine resources may be exclusive, primary, or secondary, and may be further classified into rights of occupation and use. In general, exclusive rights are locally handed down from time immemorial through ancestral families, spirits or gods. Possession of the 'property' is validated by traditional associations that are partly historical and partly mythological, and the myths, legends and history of the region are rich in references to islanders' exclusive rights to their islands' resources (Pulea 1985). (The titles are never usually in question, although boundaries are a common cause of dispute.)

Various criteria govern the rights of individuals to natural resources. Inheritance, ancestral interests, and the network of social obligations and cooperative relationships within clans and tribes provides stability and perpetuates the locally perceived systems of ownership and rights.

Commonly, as with most resources, since the first settlement of most Oceanian islands the rights to fish around reefs in defined territories and the locations for landing boats on beaches have been defined by customary law. Typical is the case of Vanuatu, where the boundaries of a person's fishing spots are determined by where his ancestors landed on the island, or by later negotiation (Taurakoto 1984).

The concept of unrestricted ownership rights to natural resources is not found in all customary systems in the Pacific. In many societies land is disposed of by a chief, who exercises his authority — largely via the imposition of taboos and other restrictions — on behalf of the entire community. For example, in pre-contact Kiribati, and probably Tuvalu as well, landowners had exclusive tenure to the reefs and lagoons adjacent to their lands (Zann 1985). Few details of these traditional systems of sea tenure, which have broken down over the last century, have been recorded. In southern Kiribati the elders of the meeting house ruled clan-owned lands and the reefs and lagoons adjacent to their own land. In the northern atolls, on the other hand, one man (the so-called king) controlled a large tract of reef and lagoon, and dispensed the fishing rights to the various clans of the area.

Such traditional rights can be more accurately defined as those to use rather than those to own. Further, rights to use can be exclusive since they can imply that primary rights holders may have a subsidiary right to prevent others from using certain

resources within the area over which traditional control is exerted (Pulea 1985).

Primary rights are often those to which a group, or occasionally an individual, is entitled via inheritance, i.e. a birthright. In general only secondary rights can be acquired through marriage, by traditional purchase, or in return for services rendered.

Acquisition and Transfer of Rights In some areas provisions in the system of exclusive marine tenure permitted temporary and occasional shared usage by other social units. For example, in peacetime, people could seek species not available in their own waters in the territory of another group. Communities were also permitted to fish elsewhere when their usual waters were temporarily too rough.

Under such circumstances the temporary user paid the rights owners for the privilege with a portion of the catch. Exclusive fishing rights were sometimes transferred permanently from richer to poorer communities, as Palau (Johannes 1981), or the Lau Islands of Fiji (Baines 1982).

Sea Rights Depend on Social Status A widespread principle is that islanders hold sea rights by virtue of their status as members of a social group (Sudo 1984), and that the degree of social stratification within a community is reflected in the local pattern of sea tenure. Such groups range from village through clans, sub-clans, and the like, to the family. Social groups are commonly ranked by the chronological order in which their ancestors settled on an island, as on Satawal, Central Caroline Islands (Sudo 1984); or in a village, as in the Lau islands of Fiji (Baines 1982).

Many Oceanian societies do not have the concept of dividing natural resources and the space that they occupy into aquatic and terrestrial components. As a consequence, the principles of sea tenure and the rights to exploit marine resources differ little if at all from those that govern land tenure and the use of terrestrial resources. Further, people, culture and society are commonly seen as integral parts of nature, and vice versa. Holding such a world view, the entire physical, economic and spiritual life of some communities is centred on the natural resource assemblage and the resource space belonging to that community. In the Pacific this is apparent in societies as diverse as Fiji, in Melanesia (Baines 1982), Yap, in Micronesia (Schneider 1974; Lingenfelter 1955; Labby 1976), and the Yolngu of Northern Territory, Australia (Davis 1984, 1985).

Close examination of the relationship between resources and traditional Oceanian societies would indicate a custodial rather than possessive attitude of people towards their resources, as in Lau, in the Solomon Islands (Akimichi 1978), and in Fiji (Ravuvu 1983). This close identification of Pacific islanders with their resource is not easily comprehended. Land and reefs are not viewed as commodities to be sold or exchanged — although certain use rights might be granted by resource 'custodians' or 'owners.' The word 'owners' is also misleading, because it indicates a possessive and dominating relationship, rather than the sense of being part of the land or the reef (Baines 1985).

Thus the Fijian word *vanua* has interrelated physical, social and cultural dimensions. In biological and physical terms it means the land-water area and its plants, animals, soils and other natural resources. Socioculturally it means 'tribe,' and refers to the human occupants of an area and their traditions, customs, beliefs, values, institutions, and the like. As a whole, *vanua* refers to a social unit that is associated with an identifiable physical territory. This social unit is regarded as the human manifestation of the physical environment and its biological and physical resource assemblage, which the members have claimed for many generations, from the time of a founding ancestor (Ravuvu 1983). Land-water is seen as the extension of the self, and, similarly, its human occupants are the personification of the land-water.

(3) Marine Resources are Controlled by Traditional Authorities

Depending on social organisation, the traditional authority controlling marine resources varies. Four principal types can be recognised: traditional leaders, traditional religious leaders, specialists and rights owners.

In most societies a group of traditional leaders or an organisation, usually the village councils, controls and conserves marine resources. Such persons or organisations have the right to regulate the use of particular tracts of the community's sea space, as well as the responsibility to protect resources against overexploitation. Commonly, traditional leaders receive their authority or status from the head of the first and highest ranking kin group, which has proprietary rights over land and sea.

On Satawal Island, of the Central Carolines, for example, the eight clans are ranked according to

their order of arrival on the island. The three highest are regarded as the 'original' clans and are known as the 'clans of the chiefs.' The others, more recent arrivals, are the 'clans of the commoners.' The eldest man in the senior line is the chief. He controls clan lands and allocates them to the lineage members. One chief, the 'Chief of the Sea,' controls all fishing activities. Fishing grounds around the reef are open to everybody, but women have rights only within the reef. Fishing in all other areas is strictly controlled by the chief, and his prior approval must be obtained to exploit the distant and separate reef areas (Sudo 1984).

Throughout the Marshall Islands the paramount chief traditionally claimed the reef. He could place a taboo on sections of it, usually near the lagoon entrance, which was rich in schooling fish (Sudo 1984). The inhabitants of the atolls were generally allowed to utilise freely other parts of the sea space, whereas outsiders had to seek prior permission (Tobin 1958). Thus on Ulul atoll, for example, islanders can fish freely anywhere in the island's sea territory, apart from one particularly wide and fish-rich tract of reef flat near a large reef passage, which is reserved for the exclusive use of the chief's clan (Sudo 1976).

On Etal atoll, in the Mortlock Islands, the most important kin groups and units of land ownership are matrilineal descent groups, clans or subclans. All clans are ranked by their order of arrival on the island. The head of the first is regarded as the 'paramount chief' of the atoll. The head of this clan holds proprietary rights over all land and sea, which forms the basis of its suzerainty over all later-coming clans (Nason 1971). The waters of Etal atoll are divided in those areas adjacent to the reef and the open sea, the latter being relatively unimportant to the islanders. Both areas are divided among the clans and subclans, which have exclusive rights to their tracts. Members of other clans must seek prior permission to fish in the rights area of another clan, for which they must pay by presenting 25–50% of their catch to the exclusive rights holders whose waters they work (Nason 1971).

In Palau (Johannes 1981), Pohnpei (Fischer 1958), and Satawal (Sudo 1984), in the Central Carolines, inshore waters were considered the common property of all islanders or villagers, and village fishing rights were controlled by a chief or village council.

In Palau (Johannes 1981) public land is owned by the village and administered by the village council. Villagers can freely exploit these areas, whereas inhabitants of other villages must first obtain prior approval from the village council. In some cases they are required to pay a monetary fee for the privilege. Nearshore fishing rights owned by each village are controlled by the chief or village council, and villagers can undertake any kind of fishing in this area. Traditionally, villagers of Kayangel and Ngarhelong shared equal rights to Ngerael and Kossol reefs. Districts can also arrange for reciprocal exploitation of their territory, as in the case of Ngardmau and Ngaremlengui for the trochus catch.

On Pohnpei (Fischer 1958) an inner reef, coral heads, an outer barrier reef and small coral island biotopes are distinguished. Together, these sections of the sea were regarded as the 'home waters,' and were strictly divided among the villages. Villagers enjoy the rights to these waters, which are regarded as belonging to the chief of the village, and they may freely operate therein, without asking permission of the chief of the village. The open sea beyond the barrier reef is not fished by the islanders.

Research Topics

(1) Total Resource System

Since systems specifically designed to manage fishery resources cannot be separated from the sociocultural and ecological systems in which they are embedded, at a minimum information is required on the following parameters of the larger system:

(a) The structure, distribution, and productivity of the system;
(b) The basic aspects of the biology of the relevant living components;
(c) Energy flow in the combined human community and natural resource base;
(d) Power structure, and social controls and their enforcement;
(e) Harvest productivity and a definition of surpluses that may be available after local needs have been satisfied;
(f) Distribution or marketing systems and the role of intermediaries;
(g) The cash absorption capacity of the system, as well as cash flows within it;
(h) Peer group or other pressures as resource access or income levelling devices within the system, and a determination of mechanisms that exist for maintaining such devices;

(i) The comparative advantages of self-sufficiency as economically and ecologically appropriate strategies within a community;
(j) The traditional knowledge base(s) and transfer techniques that support the resource system.

(2) Traditional Fisheries Management System

Given the worldwide phenomenon of the impingement of externally controlled, commercial, and large-scale fisheries on inshore waters hitherto controlled locally by traditional, small-scale fishing communities, and an increasingly frequent official realisation of the need to counteract this tendency (e.g. Bailey 1986), a critical area for research is the nature and characteristics of the boundaries of traditional fishery resource territories, and the rights associated with them. There is, thus, a need to identify and define traditional marine resource boundaries, in order to provide an effective legal basis for traditional activities while accommodating compatible commercial development.

In an attempt to facilitate abstraction of comparative data on an areal basis from secondary sources, these research needs have been posed below as related sets of questions.

Nature of Boundaries

-What indications are there that traditional marine boundaries exist (existed)?
-What are (were) the purposes of these boundaries (e.g. to protect resources, to allocate resources, to manage disputes, to demonstrate group identity, etc.)?
-How are (were) such boundaries defined traditionally, and how did they evolve?
-What criteria are (were) used to locate boundaries (e.g. depth contours, prominent landmarks, 'seamarks', seaward extension of land boundaries?
-What is the seaward extent of the boundaries, and how are (were) they fixed?
-Are (were) the boundaries claimed by one community recognised by other groups in the locality?
-Have traditional boundaries changed according to changed needs, altered perceptions of the resources contained, geomorphological changes, usurpation, etc.?
-Do (did) internal subdivisions exist within the outer boundaries? (If so, repeat the above questions per section of subdivided area.)

Resources Contained within Traditional Boundaries

-What is (has been) the traditional significance of the contained resources to the community claiming the territory?
-What is (has been) the significance of contained resources to outsiders?
-What is the nature of the rights to resources within the bounded area?
-Can traditional rights be transferred? If so, under what conditions, how and to whom? If not, why not?
-What is the relationship between resource territories and the associated rights defined by traditional or customary law, and those defined by State Law?

Permeability of Boundaries

-How permeable are traditional rights boundaries?
-Can outsiders exploit marine resources in the area? If so, under what conditions (e.g. compensation, fee, reciprocity) and with what limitations (e.g. gear type, species, seasonality, kinship, etc.)? If not, why not?
-Is provision made for innocent passage through the territory? Are any conditions imposed?
-To what extent are provisions made for adjustments to access owing to physical (e.g. geomorphological) change?

Nature of Boundary and Resource Control

-What is (was) the source of traditional authority governing resource within the bounded area(s)?
-What are (were) these mechanisms for enforcing the observation of rights and the integrity of the bounded area?
-What are (were) the methods of managing and resolving disputes over rights and boundaries, both among community members, and between the community and outsiders, and how effective are (were) these methods?
-What are (were) the provisions, if any, for compensation where boundaries or rights were transgressed, both by community members and outsiders?

Adaptation of Boundaries and Rights

-How robust is (was) the system in its present (past) cultural context?
-How robust is (was) the traditional system in relation to commercial and/or cultural intrusions?
-What might be (were) the consequences of local boundary formalisation by state law (e.g. legal definition and recognition)?

(3) Linking Traditional and Commercial-Industrial Systems

-Can links be established between unmodified traditional communities and the larger national (or international) economy?

-Do complementarities exist between given traditional fishery systems and national coastal resource development priorities?

-Can excess productivity and specific commodities produced by the traditional sector be used to fulfil national and/or international market demand?

-Can the negative impacts of a cash economy towards exploitation of resources controlled by traditional societies be mitigated?

-Will energy-intensive harvesting permanently deplete standing stocks of living aquatic resources?

-What useful links can be made between the traditional system and the development of appropriate technologies and institutions?

-Can mechanisms that ensure limited access be maintained under conditions of high energy harvesting?

-In the long-term, can local resources yield enough to justify the cost of high energy harvesting techniques?

Conclusion

It has frequently been asserted, although usually with scant proof, that the norms and institutions developed by systems of traditional sea tenure to control access and techniques could find a wider and more practical application in the solution of modern and larger-scale problems, principally by ensuring equitable access to fisheries, as well as in managing and enforcing conservation measures to ensure the sustainability of coastal fisheries. The thesis generally asserts that the more the responsibility for the control of local resources can be left to local, traditional users, the fewer will be the social, political, legal and conservation-related problems that must be addressed by governments.

Verification of such assertions is still lacking, and it must be cautioned that wholesale transfers of concepts would be hazardous at the very least, since such systems, by definition, arise from the deeper cultural patterns of the societies in which they are enmeshed (Akimichi and Ruddle 1984; Durrenberger and Palsson 1987). It is also important to realise that the 'fossilisation' of tradition through explicit, detailed legal definition in the terms of state law may weaken the adaptive flexibility of a traditional system (Ruddle and Johannes 1985). Clearly, more than a study of just the local, traditional fishery alone is required; rather, research must focus on entire national systems of fishery production, and particularly on the relationship between household (traditional) and capitalistic (modern) production within this system.

These inherent difficulties need not preclude attempts to transfer some of the underlying principles on which some traditional systems are based. However, much interdisciplinary research — based on combined anthropological, biological, and economic approaches — is first required to elucidate those principles, as well as to correct many of the misplaced concepts and erroneous interpretations that have characterised some of the earlier research on the topic. Among the latter, the badly misunderstood concepts of property and ownership, in particular, are in urgent need of correction (Durrenberger and Palsson 1987).

The application of traditional knowledge and management practices to the solution of contemporary marine resource management problems is also a relatively new approach, in Western terms, but one that is now the focus of considerable academic and applied interest. It is largely as a consequence of this newness that the relevant concepts and methodologies are not yet well-defined, as the disparities in the literature of any one discipline (largely anthropology, to date), as well as among disciplines, amply illustrate. Nevertheless, it is now generally accepted that it would be of great practical value if the best of modern marine resource management practices could be blended with the best of their traditional counterparts. Such strategies require not only investigation of traditional coastal resource systems, but also the thorough study by social scientists of the cultural matrices within which they are inextricably embedded. The design of management schemes should include as much as possible effective indigenous strategies. Schemes should also be as simple as possible, to mitigate the potentially high social costs of regulation (Wilson 1982). In this, many traditional sea tenure systems from the Pacific Basin may prove instructive in terms of their cost effectiveness and social acceptability.

References

Akimichi, T. 1978. The ecological aspect of Lau (Solomon Islands) ethnoichthyology. Journal of the Polynesian Society, 87, 301-326.

1986. Conservation of the sea: Satawal, Micronesia. In: Anderson, A., ed., Traditional Fishing in the Pacific. Honolulu: Bernice P. Bishop Museum.

Akimichi, T., and Ruddle, K. 1984. The historical development of territorial rights and fishery regulations in Okinawan inshore waters. In: Ruddle, K., and Akimichi, T., ed., Maritime Institutions in the Western Pacific. Senri Ethnological Studies No. 17. Osaka, National Museum of Ethnology, 37-88.

Bailey, C. 1986. Government protection of traditional resource rights — the case of Indonesian fisheries. In: Korten, D.C., ed., Community Management; Asian Experiences and Perspectives. West Hartford, Conn., Kumarian Press, 292-308.

Baines, G.B.K. 1982. Pacific islands: development of coastal marine resources of selected islands. In: Soysa, C.H., Chia, L-S., and Collier, W.L., ed., Man, Land and Sea: Coastal Resource Use and Management in Asia and the Pacific. Bangkok, The Agricultural Development Council.

1985. A traditional base for inshore fisheries development in the Solomon Islands. In Ruddle, K., and Johannes, R.E. ed. The Traditional Knowledge and Management of Coastal Systems in Asia and the Pacific. Jakarta, UNESCO, 39-52.

Baines, G.B.K., Johannes, R.E., Pulea, M., and Ruddle, K. (n.d.) Traditional Fisheries Rights in the South Pacific: A Guide to their Investigation and Application. Honiara, Forum Fisheries Agency (in press).

Copes, P. 1972. Factor rents, sole ownership and the optimum level of fisheries exploitation. The Manchester School of Economic and Social Studies, 40(2), 145-163.

Crutchfield, J.A., and Pontecorvo, G. 1969. The Pacific Salmon Fisheries: A Study of Irrational Conservation. Baltimore, The Johns Hopkins Press for Resources for the Future.

Davis, S. 1984. Aboriginal claims to coastal waters in North-Eastern Arnhem Land, Northern Australia. In: Ruddle, K., and Akimichi, T., ed. Maritime Institutions in the Western Pacific. Senri Ethnological Studies No. 17. Osaka, National Museum of Ethnology, 231-251.

1985. Traditional management of the littoral zone among the Yolngu of North Australia. In: Ruddle, K.,and Johannes, R.E., ed., 1985. The Traditional Knowledge and Management of Coastal Systems in Asia and the Pacific. Jakarta, UNESCO, 101-124.

Durrenberger, E.P., and Palsson, G. 1987. Ownership at sea: Fishing territories and access to sea resources. American Ethnologist, 14(3), 508-522.

Fischer, J.L. 1958. Contemporary Ponape Island land tenure. In Young, J.E. de, ed. Land Tenure Patterns in Trust Territory of the Pacific Islands. Guam, Trust Territory Government, 76-159.

Gordon, H.S. 1954. The economic theory of a common-property resource: the fishing. Journal of Political Economy 62(2), 124-142.

Johannes, R.E. 1978. Traditional marine conservation methods in Oceania and their demise. Annual Reviews of Ecology and Systematics, 9, 349-364.

1981. Words of the Lagoon: Fishing and Marine Lore in the Palau District of Micronesia. Berkeley and Los Angeles, University of California Press.

Keen, E.A. 1983. Common property in fisheries: is sole ownership an option? Marine Policy, 7, 197-211.

1988. Ownership and Productivity of Marine Fishery Resources. Blacksburg, Va.: The McDonald and Woodward Publishing Co.

Labby, D. 1976. The Demystification of Yap: Dialectics of Culture on a Micronesian Island. Chicago, University of Chicago Press.

Lingenfelter, S.G. 1975. Yap: Political Leadership and Culture Change in an Island Society. Honolulu, The University of Hawaii Press.

Malinowski, B. 1935. Coral Gardens and their Magic. London, George Allen and Unwin.

McGoodwin, J.R. 1984. Some examples of self-regulatory mechanisms in unmanaged fisheries. FAO Fisheries Report 289, Supplement 2, 41-61, Rome, FAO.

Nakayama, M., and Ramp, E. 1974. Micronesian Navigation Island Empires and Traditional Concepts of Ownership of the Sea. Extension Services Course Guide Vol. 2, Land Tenure, 252-257. Suva, University of the South Pacific.

Nason, J.D. 1971. Clan and Copra: Modernization on Elal Island, Eastern Caroline Islands. Seattle, University of Washington, Department of Anthropology (Ph D dissertation).

Pulea, M. 1985. Customary Law Relating to the Environment South Pacific Region 'An Overview'. Noumea, South Pacific Commission Environment Programme.

Ravuvu, A. 1983. The Fijian Way of Life. Suva, Institute of Pacific Studies, University of the South Pacific.

Ruddle, K. 1989. Social Principles Underlying Traditional Inshore Fishery Management Systems in the Pacific Basin, Marine Resource Economics 5(4) (in press).

Ruddle, K., and Akimichi, T., ed. 1984. Maritime Institutions in the Western Pacific, Senri Ethnological Studies 17. Osaka, National Museum of Ethnology.

Ruddle, K., and Johannes, R.E., ed. 1985. The Traditional Knowledge and Management of Coastal Systems in Asia and the Pacific. Jakarta, UNESCO.

Schneider, D. 1974. Depopulation in the Yap Tabinaw, In: Smith, R.J., ed., Social Organization and Applications in Anthropology — Essays in Honor of Lauriston Sharp. Ithaca, Cornell University Press, 94-113.

Scott, A. 1955. The fishery: the objectives of sole ownership. Journal of Political Economy, 63(2), 116-124.

Sudo, K. 1976. A preliminary report on social organization in the Ulul Islands, Micronesia, Annual Report of Social Anthropology, 2, 202-220. Tokyo, Kobundo.

1984. Sea tenure in Micronesia. In: Ruddle, K., and Akimichi, T., ed. Maritime Institutions in the Western Pacific. Senri Ethnological Studies No. 17. Osaka, National Museum of Ethnology, 203-230.

Taurakoto, P. 1984. Customary rights to reefs and landings. In: Lamour, P., ed. Land Tenure in Vanuatu. Suva, Institute of Pacific Studies, University of the South Pacific.

Tobin, J.A. 1958. Land tenure in the Marshall Islands. In: Young, J.E. de, ed., 1958. Land Tenure Patterns in Trust Territory of the Pacific Islands. Guam, Trust Territory Government, 1-75.

Wilson, J.A. 1982. The economical management of multispecies fisheries. Land Economics, 58(4), 417-434.

Zann, L.P. 1985. Traditional management and conservation of fisheries in Kiribati and Tuvalu atolls. In: Ruddle, K., and Johannes, R.E. ed. 1985. Traditional Knowledge and Management of Coastal Systems in Asia and the Pacific. Jakarta, UNESCO, 53-77.

Inshore Fisheries

Appraising Inshore Fishery Resources in Pacific Island Countries

Michael King and Alistair McIlgorm[1]

Abstract

The inshore fishery resources of Pacific Island countries are outlined, and methods of their appraisal are discussed.

The decision whether or not to proceed with the development of a particular fishery is usually based on data collected during a necessarily short field survey. It is therefore imperative to maximise the information obtained by collecting data over a broad area which includes not only biological aspects of the stock but marketing and economic viability under conditions of limited shore-based infrastructures for processing and marketing. In many cases in the past, surveys have been restricted to addressing biological aspects of a potential fishery.

Crucial biological parameters are the expected catch rates (catch-per-unit-effort) and the level of exploitation at which catches are sustainable. Economic and marketing appraisals both require price and cost information even though assumptions must be made regarding potential operational size.

A structured approach to collecting such minimal information is presented. Basic analyses of these data allow a more meaningful appraisal of fisheries potential.

Introduction

THE appraisal of an unfished resource precedes the development and management of a fishery. In Pacific Islands, fisheries have been appraised and managed within a framework of traditional knowledge which has been accumulated over more than 1000 years. Communal groups have had customary rights over adjacent coastal areas, such as lagoons and coral reefs, and fish stocks have not been subject to problems of open access (Munro and Williams 1985). In many islands, however, customary rights are being eroded (Munro and Fakahau 1988) with increased local population sizes and a trend towards a money-based economy. The introduction of new technologies (ranging from monofilament nets to purse seiners) have not only increased pressure on existing resources but allowed access to previously inaccessible resources.

The development which follows an appraisal may fail for two reasons. First, the costs of fishing, transporting and marketing the catch may be too high and second, the stock may be overexploited, involving falling catch rates and eventual collapse of the fishery. It is for this reason that we consider it imperative to collect data over a broad area which includes not only biological aspects of the stock but marketing and economic viability under conditions of limited shore-based infrastructures for processing and marketing. In many cases in the past, surveys have been restricted to biological aspects of a potential fishery.

Inshore Fishery Resources

The large diversity of tropical species, whether terrestrial or marine, is well known and causes one of the major problems of fisheries development and

[1] School of Fisheries, Australian Maritime College, Launceston, Tasmania 7250, Australia.

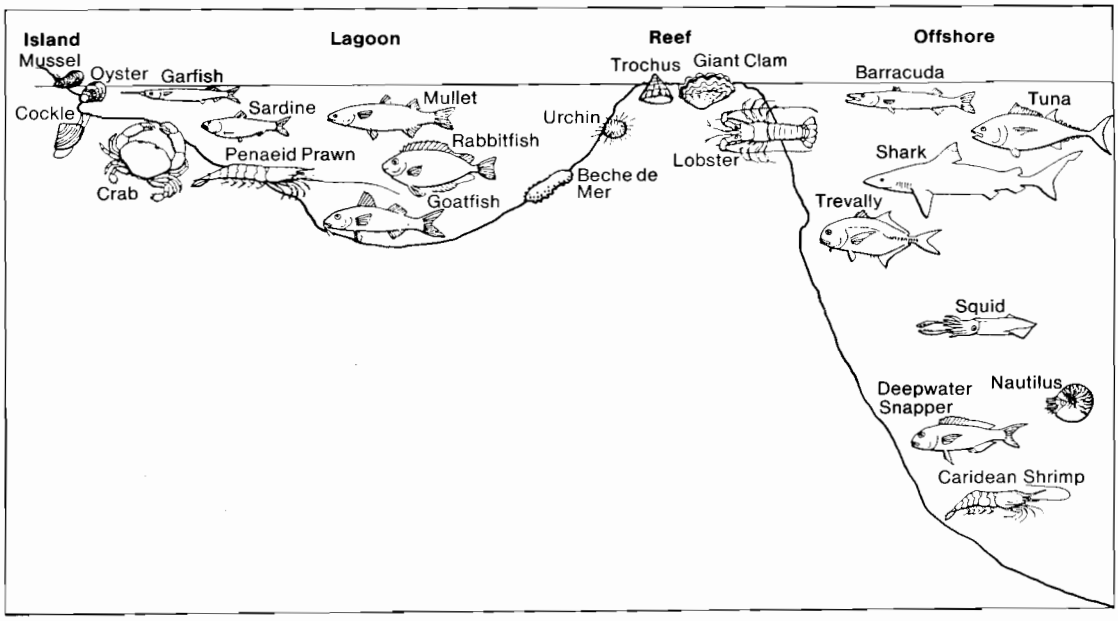


Fig. 1. The distribution of fisheries resource species on a profile of a typical tropical high island.

management in tropical islands. A list of marine species used as food from tropical islands reads as a compendium of the Animal Kingdom and extends into the Plant Kingdom.

Table 1. Inshore fisheries resource species of Pacific Island countries.

Fish
coastal pelagic species — mackerel, etc.
shallow-water snappers, emperors, etc.
deep-water snappers, groupers, etc.
sharks
baitfish (for tuna line-and-pole fishing)
Crustaceans
spiny lobsters
penaeid prawns or shrimps
deep-water shrimps
crabs
Molluscs
gastropods — trochus, green snail
bivalves — giant clams, pearl shell
Echinoderms
beche-de-mer
Others
commercial algae
precious corals
turtles

A list of inshore species identified (at a recent regional workshop in Noumea; Anon. 1988) as of most interest in Pacific Islands is shown in Table 1. The general distribution of these resources, or potential resources, along a profile of a typical tropical 'high' island is suggested in Fig. 1.

Most of the inshore resources in Pacific Islands are small and therefore highly vulnerable. The start of commercial exploitation, or the switch from artisanal to commercial fishing, will often result in overexploitation. It is also important to note that there may be interactive effects between artisanal/subsistence fishing and commercial fisheries. The effect of commercial fishing in reducing the catch available to subsistence fishermen is of concern in many Pacific Islands (Anon. 1988).

A Structured Resource Survey

The problems of fisheries resource appraisal are not exclusively related to any single discipline such as fisheries biology or economics but include aspects of fishing gear and postharvest technology.

In general, small countries cannot afford a multidisciplinary approach to fisheries appraisal. In most cases, an appraisal of potential or existing fisheries resources will consist of the analysis of data collected during a necessarily short field survey. The data collected will usually not be adequate to allow more sophisticated analyses of yield and cost and

revenue functions. Nevertheless, surveys should attempt to address baseline aspects of the stock, catch, marketing and economic viability. In considering the development of any commercial fishery, the following basic questions are, therefore, most relevant:

a) Are the catch rates (based on preliminary surveys) high enough to justify commercial development? If they are, at what level of exploitation are the catch rates sustainable?

b) Is the market value of the product (price/kg paid) likely to be high enough to offset the costs of fishing, and provide a profit incentive to fishermen?

Approaches to obtaining answers to the above questions are based on the structured survey shown in Fig. 2, and are discussed in the following section. An initial, small-scale survey should always be carried out and if, at any stage, results are not encouraging, the option of cancelling or discontinuing should be invoked to cut the costs involved in a major research effort.

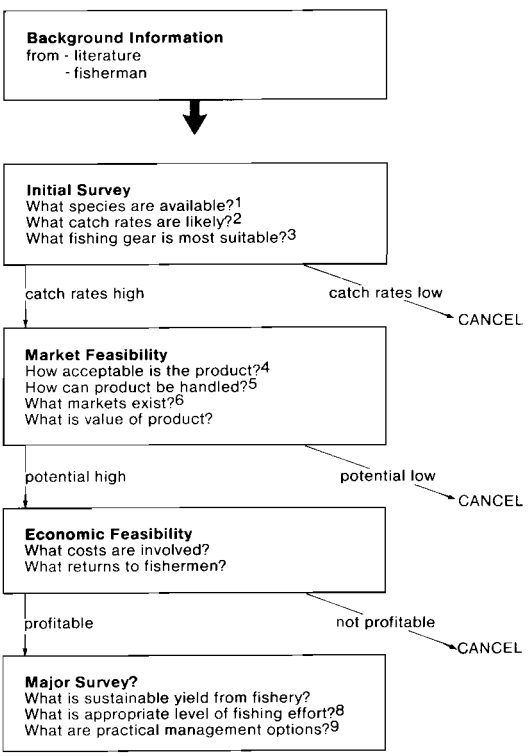


Fig. 2. Sequential steps in appraising potential fishery resources. Note the option to cancel at each stage. The superscripts refer to footnotes by number.

Some small-scale fisheries have been successfully developed without adequate economic analyses largely because catching and processing costs have been low. Beche-de-mer (sea cucumbers), for example, have not been a traditional food in Pacific Islands, but are now a valuable item of export to Southeast Asia. They are collected by hand, and are boiled and smoked in village-made equipment. In Fiji, catches have increased rapidly to a staggering 6650 t live weight equivalent in 1988 (G. Preston, pers. comm.) to over twice the catch of tuna in the same period. Although initial profits have been large (mainly to the 'middle-men' in the operation), it is unlikely that the resource will survive this rate of exploitation.

In other potential fisheries, where a higher level of technology is required and fishing costs are higher, commercial exploitation has failed. Deep-water caridean shrimps, for example, have been caught in surveys using baited traps in depths between 200 and 800 m off many tropical Pacific Islands (King 1986, 1988). The discovery of these shrimps has encouraged much interest in commercial exploitation. Although shrimps have been found in virtually all islands where surveys have been carried out, successful long-term fisheries have not been established, except in the Hawaiian Islands. In most cases, surveys have been of a biological nature and have not addressed basic economic parameters such as likely fishing costs and market prices for the product. For very little extra effort, these surveys could have been extended to include the collection of such data. To have done so would have prevented embarkation on a fishery which although biologically viable is not so economically.

Approaches to appraising fishery resources, and avoiding the problems outlined above, are discussed in the following two sections.

Potential Yields and Appropriate Levels of Effort

There is usually some pressure for fisheries scientists to provide answers on how 'big' a fishery is likely to be — what weight of fish can be taken and how much fishing effort can be put in? Unfortunately, these questions are impossible to answer with any precision. Even in existing fisheries, where extensive data exist, it is usually impossible to predict yields within about 30%. With extensive data, options include surplus yield models (e.g. Schaefer 1954), dynamic pool models (Beverton and

Holt 1957) or more modern versions of these (Fox 1970, 1975; Schnute 1977; Deriso 1980; Walters 1980, 1986).

In the appraisal of a 'new' fishery it is generally impossible to apply the above models. Surplus yield models, in particular, require many years of catch and effort data. An exception may be where data are collected from different areas (with similar ecological characteristics) which are subjected to varying degrees of fishing pressure. A study in American Samoa identified 11 discrete reef areas which were exclusively fished over long periods by people from adjacent villages. Data from this study were analysed by Munro (1984) as shown in Fig. 3.

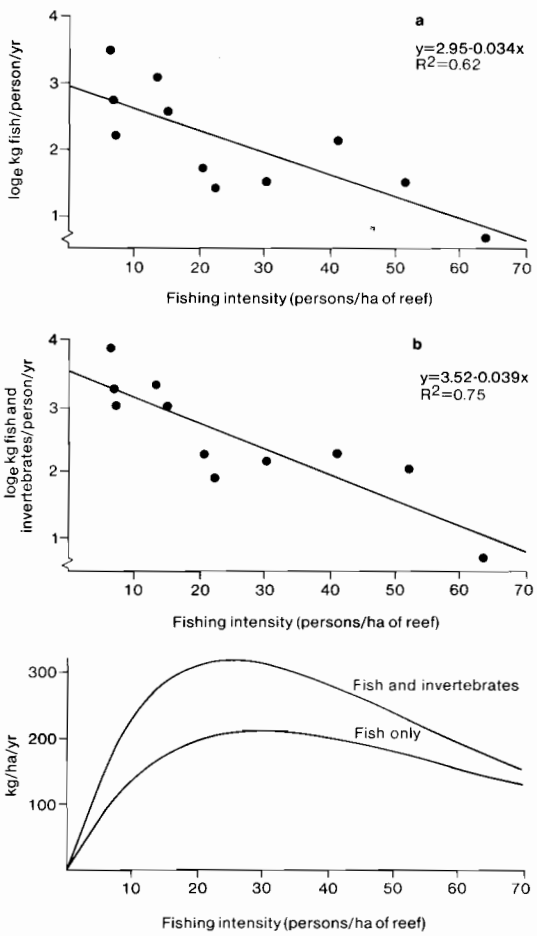


Fig. 3. *Top*: Log regression plots of catches per person per year against fishing intensity, expressed as persons per hectare of reef, for 11 villages in American Samoa — (a) fish and invertebrates combined; (b) fish only. *Bottom*: Surplus yield curves derived from the regression lines (from Munro 1984).

Two important points should be noted from Fig. 3:

1) At the point of maximum yield, catch-per-unit-effort has been reduced to about half the initial values; this suggests that initial catch rates in survey work should be reduced by one half in predicting long-term viability (see Fig. 2, footnote 2), and,

2) the maximum economic yield from the fishery will be obtained at fishing efforts less than those needed to obtain the sustainable yield.

Dynamic pool models may be attempted if extensive biological data are collected during a major survey, but this is unlikely to be so. Such data are available for deep-water shrimp (King 1986, 1988b), and yield-per-recruit curves are shown in Fig. 4. It should be noted, however, that although the curves may suggest how yield may be maximised by controlling age at first capture, they will provide no indication of sustainable yield (unless recruitment can be estimated by cohort analysis or other means). If extensive biological data are collected (or can be extrapolated from other fisheries) the application of simulation models is a better option, particularly considering the widespread availability of microcomputers and fisheries software in the region (King 1988a). Economic and stochastic factors can also be included in simulation models and an example is given in the following section.

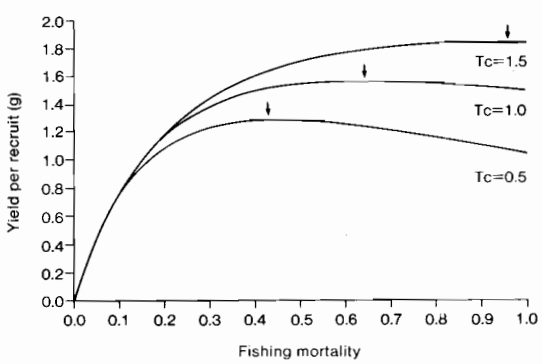


Fig. 4. Yield-per-recruit curves for ages at first capture (Tc) of 0.5, 1.0, and 1.5 years for deep-water shrimp.

Although no-one suggests maximum sustainable yield (MSY) — the maximum catch rate that can be repeatedly taken from a stock without affecting its reproductive capacity — as a goal in fisheries management, the concept can provide an absolute upper limit on likely catches and a useful reference point for economic analyses. Several 'quick and

dirty' methods are available to obtain an estimate of potential annual yield (Gulland 1983; Garcia et al. 1987). Gulland's method requires only estimates of stock size, or biomass (B), and the instantaneous natural mortality rate (M):

$$YIELD = 0.3*M*B.$$

The main difficulty with the method is in obtaining accurate estimates of stock size. In the case of beche-de-mer, divers can be used to count the numbers per unit area or quadrat, and extrapolate the data to estimate the stock size (with confidence limits) in a lagoon. Deep-water shrimps, on the other hand, cannot be counted directly. They are caught in traps which have an unknown area of influence. As traps spaced at more than about 50 m apart appear not to compete with each other, it may be assumed that a single trap attracts shrimps in from a circle with a radius of half this distance. Gulland's equation (with M = 0.66/year) provides a yield estimate of about 200 kg/km^2. An alternative method of obtaining estimates of stock size is by depletion (e.g. Polovina 1986); this method is currently being used on stocks of snapper as well as deep-water shrimps in Pacific Islands. An isolated unit stock is fished heavily and the reduction in catch-per-unit-effort noted; a graph of catch-per-unit-effort against cumulative catch provides an estimate of initial stock size at the x-axis intercept.

An alternative to relying on such 'quick and dirty' estimates of yield has been proposed by several authors including Hilborn and Sibert (1985). This strategy (termed 'adaptive management') relies on monitoring catch and effort in the developing fishery and being prepared to respond to declines in catches when they occur; it involves deliberately overfishing the resource to determine sustainable levels of fishing effort. Its main defect is that it relies on a government having the political willpower and means to reduce effort when required. During a recent workshop involving South Pacific fisheries personnel (Anon. 1988), delegates made special note of the difficulties of a government taking politically unpopular steps to reduce the number of fishermen once it is discovered that a fishery is overexploited. In fact, it is usually easier to reduce effort by distant water fishing nations (DWFNs) in offshore fisheries than it is to reduce effort by the nationals of one's own country. For this reason, we think that it is important that appraisals include some initial estimate (educated guess?) of the size of a potential resource and the appropriate number of fishing units. In this respect, it is tempting to be conservative at the expense of early potential gains to avoid the greater evil of overexploitation.

Economic Viability

As previously stated, very few resource appraisals have included basic price and cost information. An example where an attempt has been made to collect such data is given in a recent survey for deep-water shrimp in Kiribati (Crutz and Preston 1987); their data are summarised in Table 2.

Table 2. Economic analysis of deep-water shrimp trapping operations in Kiribati using the vessel Nei Tewenei (adapted from Crutz and Preston 1988).

Item	Total cost	Annual cost
a) *Initial Investments*	($A)	($A)
Initial vessel cost	100000	
Total Investment	100000	
b) *Fixed Costs*		
Crew wages (Skipper plus 6 crew)		24000
Vessel repairs and maintenance		15000
Amortisation of vessel over 10 years		10000
Insurance		10000
Supplies ($A3.60/day)		5040
Total Annual Fixed Costs		64040
c) *Operating Costs*		
Trap replacement costs		9200
Float and rope replacement costs		12500
Fuel oil ($A200/day)		40000
Ice (200 kg/day @ 0.25/kg)		10000
Bait (100 kg/day @ 0.50/kg)		10000
Other items		4000
Total Annual Operating Costs		85700
Total Annual Costs		149740
d) *Income*		
1 kg shrimp/trap × 200 traps/day × 200 days/year = 40000 kg/year.		

The most basic of economic analyses involves examining the possible effects of catch rates, fishing effort, and product price level on one vessel's net return. Long-term viability would involve financial project appraisal techniques (Campleman 1976; Lawson 1985). An analysis of the data from Table 2 is shown in Fig. 5, in the form of curves where Net Present Value equals zero. It is notable that the mean catch per trap and realisable market prices in Kiribati are unlikely to be sufficient to give long-term financial viability. In this case, it would be unlikely that further financial analyses would be attempted.

Full bioeconomic simulation modelling can help in predicting the possible outcomes of various fishing levels and strategies. Simulation models allow the user to deal with complex systems and 'try

out' various management strategies. In a technique known as Monte Carlo modelling, simulations may be run repeatedly to estimate the probability of obtaining desirable outcomes (and the risk of undesirable ones!). A sample output from a long-run (30-year) simulation program based on deep-water shrimps is shown in Fig. 6.

The program has statements defining stock size/ km^2 of outer-reef slope, growth, natural mortality, fixed costs, running costs, and value of catch. Recruitment, which is often unknown, is related to stock size using Ricker's (1954) equation although other models could be substituted. The program is stochastic in that recruitment is allowed to vary randomly (within a given standard deviation) about the predicted size. Catch values were also allowed to vary randomly between \$5 and \$8 per kg. The model could be made more sophisticated if discounting and external effects were introduced, but it does illustrate both the fragile nature of the resource and extent to which it can be exploited.

An unfished stock (F = 0) fluctuates around a mean of 1 350 000 individuals/50 km^2. A fishing mortality of F = 1 (approximately one vessel using 150 traps for 200 days/year) reduces the stock which stabilises at about 1 000 000; catch rates reduce rapidly from 3 kg to about 1 kg/trap, and returns,

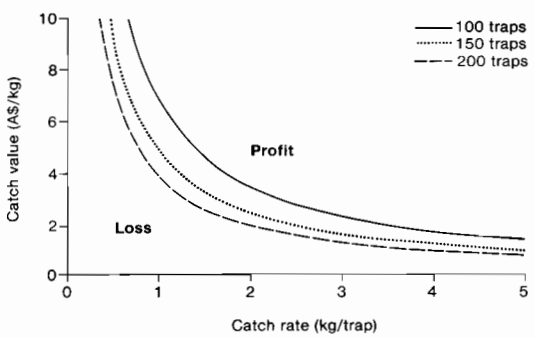


Fig. 5. Projected curves plotting combinations of price and catch-rate where NPVs equal zero for a small vessel using either 100, 150, or 200 traps in a deep-water shrimp fishery (discount rate 10%).

which are initially high, also drop and stabilise after about 3 years. Higher levels of effort cause returns to go negative, and, at F = 3, the diminished stock results in recruitment failure after about 15 years.

In summary, we consider that fishery resource surveys should be carefully designed to collect data over a broad area. Estimates of the expected catch rates, the level of exploitation at which catches are

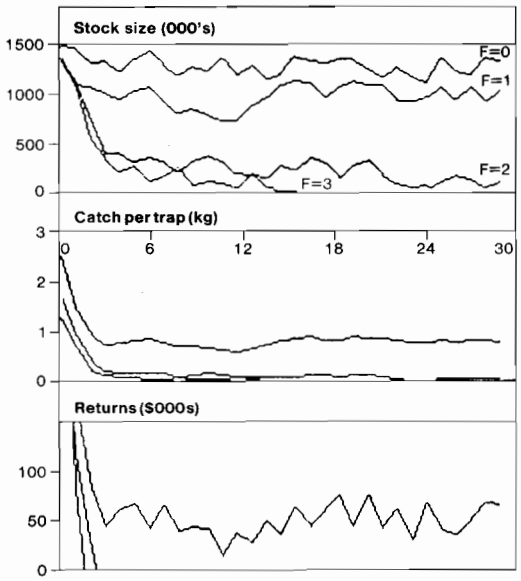


Fig. 6. A simulation showing stock size per 50 km^2, catch per trap, and returns to fishermen for three levels of fishing mortality, F = 0 (unfished), F = 1, F = 2, and F = 3. Returns in the model represent revenue minus costs — discounting cash flows and external effects, associated with the introduction of more than one vessel, are not included in this model.

sustainable, and price and cost information are the basic parameters which allow a reasoned judgment on whether or not a potential fishery is likely to be biologically and economically viable.

Acknowledgments

We thank Dr J. Wallace for his comments on this paper.

References

Allen, K.R. 1971. Relation between production and biomass. Journal of the Fisheries Research Board of Canada, 28, 1573-1581.

Anon. 1988. Report of the Workshop on Pacific Inshore Fishery Resources, South Pacific Commission, Noumea, 80 p.

Beverton, R.J.H., and Holt, S.J. 1957. On the dynamics of exploited fish populations. Fish. Invest. Minist. Agric. Fish. Food UK. Series 2, 19.

Campleman, G. 1976. Manual for the identification and preparation of fishery investment projects. Fisheries Technical Paper, 149, FAO, Rome.

Crutz, B., and Preston, G.L. 1987. Survey of the deep water shrimp resources of the Northern Gilbert Islands, Kiribati, South Pacific Commission Report. 39 p.

Deriso, R.B. 1980. Harvesting strategies and parameter estimation for an age-structured model. Canadian Journal of Fisheries and Aquatic Science, 37, 174-178.

Fox, W.W. 1970. An exponential surplus yield for optimising exploited fish populations. Transactions of the American Fisheries Society, 99(1), 80–88.

1975. Fitting the generalized stock production model by least squares and equilibrium approximation. Fisheries Bulletin, 73, 23–27.

Garcia, S., Sparre, P., and Csirke, J. 1987. A note on rough estimates of fisheries resources potential. Fishbyte, 5(2), 11–16.

Gulland, J.A. 1983. Fish stock assessment: a manual of basic methods. FAO/Wiley series on food and agriculture. John Wiley & Sons, 223 p.

Hilborn, R., and Sibert, J. 1985. Management strategies for newly developing fisheries. South Pacific Commission Newsletter, 35, 21–29.

King, M.G. 1986. The fishery resources of Pacific Island countries. Part 1. Deep-water shrimps. FAO Fisheries Technical Paper, 272.1.

1988a. Stock assessment: computer programs for use in tropical fisheries. Workshop on Pacific Inshore Fishery Resources, South Pacific Commission, Noumea, Background Paper 23, 22 p.

1988b. Topic review: deep-water shrimps. Workshop on Pacific Inshore Fishery Resources, South Pacific Commission, Noumea. Working Paper 13, 25 p.

Lawson, R. 1984. The economics of fisheries development. Francis Pinter, London.

Munro, J.L., and Fakahau, S.T. 1988. Management of coastal fishery resources in the South Pacific region. Workshop on Pacific Inshore Fishery Resources, South Pacific Commission, Noumea. Background Paper 52, 21 p.

Munro, J.L., and Williams, D.McB. 1985. Assessment and management of coral reef fisheries: biological, environmental and socio-economic aspects. Proceedings 5th International Coral Reef Congress, Tahiti, 4, 545–581.

Polovina, J.J. 1986. A variable catchability version of the Leslie model with application to an intensive fishing experiment on a multispecies stock. Fishery Bulletin, 86(2), 423–428.

Schaefer, M.B. 1954. Some aspects of the dynamics of populations important to the management of commercial marine fisheries. Bulletin of the Inter-American Tuna Commission, 1, 27–56.

Schnute, J. 1977. Improved estimates from the Schaefer production model: theoretical considerations. Journal of the Fisheries Research Board of Canada, 34, 583–603.

Walters, C.J. 1980. Comment on Deriso's delay-difference population model. Canadian Journal of Fisheries and Aquatic Science, 37, 2365.

1986. Microcomputer stock analysis using Schnute's generalization of the Deriso delay-difference model. Fisheries Software Register, 1.2, 10–11.

Managing Small-Scale Fisheries in Oceania: Unusual Constraints and Opportunities

R.E. Johannes[1]

Abstract

Pacific Island nearshore fisheries present the Western economist with unusual conditions, some of which can undermine economically sound fisheries development. For example, it is virtually impossible in many cases to obtain at reasonable cost the information on catch, effort and stocks needed for sound management. In addition, social barriers to capitalistic behaviour are widespread. Occupational pluralism is the norm. But there are also unusual opportunities for the fisheries manager in the form of an indigenous framework for marine resource management and an undervalued but sometimes very rich indigenous knowledge base. The record of development projects in Oceania is bad in terms of both economic gains and social and environmental consequences. In future, we must be as concerned with the nature, direction and implications of social and environmental changes brought about by development projects in the region as with their contributions to economic growth.

Introduction

I have been asked to try to say something useful to economists who are thinking about working on fisheries in the Pacific Islands but who have little or no previous experience there. My attempts may be presumptuous. As a biologist, my formal exposure to economics consists of one brief course 30 years ago, given, incidentally, by Tony Scott. It was a basic course on economics for fisheries biologists. Tony felt, quite rightly, that they ought not venture into the world totally ignorant of the subject.

But since fisheries biology shares a common aim with natural resource economics — the efficient use of natural resources — and because Tony captured my attention, I have followed with interest the deliberations of fisheries economists — especially with reference to tropical small-scale fisheries.

[1] CSIRO Marine Laboratories, PO Box 1538, Hobart, Tasmania 7001, Australia.

Having lived and worked in traditional fishing villages in a number of different Pacific Islands in Micronesia, Polynesia and Melanesia, I want to focus here on some of the things I wish someone had told me about the region before I started work there.

Two recent documents should be required reading for anyone venturing into Oceania on fisheries economics assignments. They are the 'Proceedings of the South Pacific Workshop on Pacific Island Fisheries Resources' published by the South Pacific Commission in 1988, and 'Integrated Renewable Resource Management for U.S. Insular Areas' (U.S. Congress, Office of Technology Assessment, 1987). Between them they offer the most comprehensive analysis of Pacific Island fisheries issues available.

The economist will be struck by the fact that while fisheries biology receives much attention in these volumes and social issues are dealt with in some

detail, little space is devoted to economics. It is not that economists have been slighted by the editors. Economists have simply not displayed much interest in the area, whereas social scientists and biologists have always been fascinated by it. The region thus presents fisheries economists with an almost virgin field. But it is a stony one.

We can list a number of impediments to fisheries development in the region: distant markets entailing high transport costs; distant sources of supply entailing high costs of supplies, fuel and maintenance; vulnerability to external economic shocks; diseconomies of scale; and the inability to support the degree of professional specialisation found in larger communities, etc. But these difficulties are characteristic of legions of isolated communities throughout the world and are not insurmountable. They are seldom overcome, however, simply by providing technological aid, fisheries training and subsidies — the usual responses of development experts and governments. Such approaches have failed miserably to lift the standards of living of artisanal fishermen in Oceania or elsewhere (e.g. Alexander 1975; Smith 1979; Lawson 1980; Ben-Yami 1980; Davis 1984; Robinson and Lawson 1986; Anonymous 1988).

Today, foreign aid donors in Africa, Latin America and Southeast Asia are widely criticised for their critical lack of comprehension of local cultural, political and environmental conditions that preclude the simple transfer of technologies and methodologies from the industrialised world. The same mistakes are also in evidence throughout Oceania, although they don't attract as much international attention because of the much smaller populations involved.

The Setting

The inshore fisheries resources of Oceania are tiny by world standards. But their importance to Island peoples has been, and will continue to be, of greater importance per capita than in perhaps any other region of the world. As well as being the main local source of animal protein, fisheries are also often viewed as the main potential source of foreign exchange (other than foreign aid) in much of the region, since land-based resources are often very limited.

Because Pacific Island nations are small, their leaders are often very accessible. It is not unusual for researchers and consultants to find themselves on first-name terms with government ministers within days of arriving. So a fisheries expert has an unusually good chance of having his recommendations listened to. The results, however, have not lived up to expectations. Despite the application of plenty of brains, sweat and good intentions, the history of fisheries development in Oceania is, in fact, a litany of failures for a number of reasons. I will touch on some of them later.

Adding to the problem is the fact that pollution due to domestic and industrial effluents, and sedimentation due to land clearing, dredging and coastal construction have become widespread in the region (Hatcher et al. 1989). This, plus the increased demand for seafood, occasioned by rapid population growth, has depleted nearshore marine resources in many areas to a point where they can no longer fully support local subsistence needs, let alone exports. Because nearshore fisheries stocks in the region are very small they are especially prone to overexploitation.

One of the commonest items to be found in Island stores is imported canned mackerel; almost all of the nations of Oceania are now major importers of seafood. This is not always because of inadequate local resources. Sometimes the problem lies with distribution. Remoter and less populated areas where nearshore fisheries resources are underexploited are still relatively common in Melanesia, despite unfulfilled demand for fresh seafood in population centres in the region. Such areas are less common in Polynesia and Micronesia.

Here I use the term 'small-scale fisheries' as it is defined by Lindquist (in MacLean 1988) to mean fisheries involving a capital cost of $2500 or less (often much less) for each fishing job. Managers of Western commercial fisheries are sometimes surprised to discover that, globally, such fisheries account for about half the catch of marine fish used for human consumption. Moreover, they employ about 24 times as many people as large-scale fisheries, while consuming an order of magnitude less fossil fuel (Thompson and Lindquist, cited in MacLean 1988).

These are the fisheries that Maclean (1988) states 'some donor agencies still feel obliged to "upgrade" into inefficient large scale fisheries!' One's view of this statement depends, of course, on one's definition of efficiency. Efficiency measured in terms of catch per unit of human energy expended is very low indeed in typical traditional Pacific Island fisheries today — sometimes <1kg/person-hour. But Islanders' notions of efficiency are often

fundamentally different from those of Western economists. For example, labour-saving technologies are sometimes adopted less as a means to increase the catch than to reduce the time spent fishing (Johannes 1978).

In fact, Pacific Islanders have many priorities and values that differ from those in the West, and some have important implications for marine resource management. I will illustrate this by discussing some unfortunate assumptions that Western fisheries experts have tended to bring with them to the region.

Keeping Capitalism at Bay

For anyone raised in a society where the accumulation of wealth is the prime mover in economic affairs, it may come as a shock to learn that in many traditional Pacific Island societies it is unimportant. Here, traditionally, profit does not motivate, capitalism is not the engine of production, and wealth does not pay dividends; rather it attracts considerable social costs.

Useem (1945: 567) said of Palau, for example, 'because economic enterprise rates low in the scale of values, the accumulation of physical goods had no effect on a person's status, sense of security or standard of living.' In much of Oceania, in fact, there is often strong social disapproval of deliberate striving to accumulate things beyond one's basic needs. Traditionally Island workers have controlled their own economic means. This rules out elevating oneself through controlling the production of others. Influential people are characterised not by the resources they accumulate, but by the resources they redistribute. As Sahlins (1974) states, 'the best (political) move, as well as the most coveted right of property is to give the stuff away.' Sharing is a key element of social security in such cultures. Fishermen imbedded in the traditional mutual support network can thus, as the Tongan economist Halapua (1982) put it, 'produce and survive without the need to respond to market incentives.' This tends to frustrate development efforts that depend upon entrepreneurial drive.

For example, time and again fisheries managers have been discouraged to find that once Island fishermen pay off their boat loans, their interest in commercial fishing diminishes. Catches quickly decline — along with the manager's visions of a thriving commercial fishery. The explanation is simple, but it is not readily apparent to the casual observer.

It is acceptable to make money beyond one's immediate needs in many Island societies if it can be seen to be used for the benefit of the community. It is thus acceptable to use money earned from fishing to pay off a boat loan, since boats are typically used not only to fish for profit, but also to transport fellow villagers and to catch fish to distribute communally.

But after the loan is paid off, profits surplus to the boat owners' immediate needs must still be used communally. Those who do not share their earnings promptly and generously with friends and relatives are often firmly censured. Such people are said in Palau, for example, to have 'crippled hands' (Johannes 1981) and are referred to in Solomon Islands as 'Mr Me' (Meltzoff and LiPuma 1983). Westerners who live in small Island villages are often asked to donate cash or material possessions for various purposes. This is liable to strike the newcomer as exploitive. But, after a while, one comes to realise that, out of politeness and the widespread perception that Westerners are unusually possessive of material things, the demands made upon Western residents in these communities are often much less than those made upon Islanders with comparable earnings. Halapua (1982) reports that *manumanu*, a word that refers in Tonga to an excessively materialistic attitude towards work, is used as an effective means of control over commerical fishermen and other participants in the cash economy in a society that disapproves of deliberate striving for the accumulation of goods beyond one's basic needs.

Saving money is also discouraged 'on the presumption that savings are secret and thus breach the ethic of sharing material wealth.' People believe savings accounts to be peculiarly European; they belong to all expatriates, rich people whose ethic is to hoard 'selfishly' (Meltzoff and LiPuma 1983: 35). Lacking knowledge of these social imperatives, resource development managers have tended to blame the failures of their projects on the 'laziness' of Island workers, and to mistake the absence of a well-developed market rationality for the absence of any rationality.

Meltzoff and LiPuma (1983: 23) provide an illustration involving Island workers and Japanese managers of a joint venture fishing project in Solomon Islands: '(The) commitment to group loyalty and harmony by (Japanese company) managers contrasts with Solomon Islands labor practices which are founded on a different culture and history. National workers frustrate Japanese expectations and managers are thus appalled by

what they see as the Solomon Islanders' casual commitment to work, disregard for authority, and lack of fidelity to the company. By Japanese standards this is an accurate appraisal. Of course, for the Islander, wage labor is but one cog of a larger economic framework, devolving on the village, wherein lies his locus of loyalty and devotion: gardening, fishing, producing copra and doing whatever else he must do to assist the clan and extended family enterprise. These people guarantee his social prosperity and protection, as, in an analogous manner, the Taiyo company guarantees them to its Japanese workers.'

Similar relations govern production throughout most of the region. As Rodman (1987: 712, 715) says of rural Vanuatu, 'almost no one...is willing to be a "full-time anything"...If most village fishermen were expected to produce for export, self-reliance for the country, measured in export dollars, would mean a loss of self-reliance in the rural areas, where the objective is to maintain one's social and economic options...regular production remains characteristic of only a few entrepreneurs in the area.'

Island communities are situated at various positions along a continuum between the largely wage-based and mainly subsistence economies. Prescriptions for marine resource management must differ depending upon the location of a particular fishing group on that continuum. Cultural barriers to a cash economy are eroding in the main centres of population and administration. But small-scale fisheries are largely a rural occupation. In the villages, towards which much fisheries development effort is directed, tradition still holds sway, and capitalistic enterprise is still viewed with distrust or outright disapproval. Even today, most fish caught by Pacific Island fishermen do not reach cash markets (e.g. U.S. Congress, Office of Technology Assessment, 1987). Fish that do not enter the cash economy tend to be left out of conventional economic analyses. But their importance as import replacements and as a source of informal employment are exceptionally high in Oceania.

It might be thought that such simple commodity production is just a transitional phase on the way to a capitalist mode of production. But some anthropologists maintain that it is a mode of production in its own right, and one that may persist indefinitely (see Rodman 1987 for review).

To compound the problem, those Islanders who are attracted to wage labour find that salaries available in public-sector employment (which often accounts for a very high proportion of total Island wages) are often much higher than those in the private sector, since the former are often supported by foreign aid. In U.S.-affiliated Pacific Islands, for example, local government wage and salary levels are nearly twice those of the private sector. Government employment also confers greater security and prestige (U.S. Congress, Office of Technology Assessment 1987). In addition, attempts by the private sector to match public-sector wages places seafood exports and import-substitution strategies at a competitive disadvantage (e.g. U.S. Congress, Office of Technology Assessment 1987).

Commercial fishing thus holds little appeal as a full-time occupation for many Islanders. One solution to the 'problem' of the disinclination of islanders to engage in sustained private-sector wage labour has been to import workers from outside the region. With regards to this problem Rodman (1987: 720) notes that 'It would be naive to view the lack of full-time involvement in fishing as an indication that the projects are failures. The contrary (such projects) can be very successful according to local criteria because islanders are able to maintain their self-reliance by fishing on their own terms.' But this creates a new problem; the presence of significant numbers of foreign fishermen in small Pacific Island societies has generated considerable tension (e.g. Meltzoff and LiPuma 1983; Wright and Kurtama 1988; U.S. Congress, Office of Technology Assessment 1987). Fishing in coastal waters for tuna bait — an important nearshore foreign fishing activity in Oceania — has generated especially troublesome problems.

Limiting Entry

It is often assumed that open-access fisheries are the norm in societies not blessed with Western sophistication. Because some form of exclusive fishing rights is necessary before a fishery can produce sustained positive economic rent, it might be assumed that establishing such rights should be the first order of fisheries business in Pacific Island countries. Pacific Islanders, however, have employed traditional fishing rights (more appropriately described by the term 'customary marine tenure' or CMT — see Hviding 1988) for centuries.

There has been much recent debate over whether CMT functions as a useful fisheries conservation measure. The question has been improperly put. It

should be: in what circumstances is CMT useful and in what circumstances is it not?

There are good examples of each. The conservation value of excluding outsiders from one's fishing grounds depends upon the ratio of existing fishing pressure to optimum fishing pressure. One can, of course, define optimum fishing pressure in various ways depending on whether biological yield, economic yield, employment or some other optimum condition is the objective. How it is defined is unimportant here. A ratio of more than one means that there is excessive pressure on the resource and that excluding outsiders will prevent additional overharvesting. But if the ratio is less than one, then excluding additional fishing pressure may sustain a departure from optimum yield through *under*harvesting. This question has been dealt with in more detail elsewhere (Johannes and MacFarlane, in press).

Since Ruddle (These Proceedings) is addressing his paper to the subject of traditional fishing rights, let me just make one final point about them. It is seldom desirable to design, from scratch, some modern form of limited entry system while ignoring CMT. What is needed, rather, are contemporary management schemes that are designed to harmonise as much as possible with existing CMT systems. Allocation is arguably the most intractable problem in fisheries management. An approach to it which is rooted in local tradition is obviously more likely to gain fishermen's acceptance.

Indigenous Management

Centuries before the need for marine fisheries conservation was even recognised in the West, Pacific Islanders devised, in addition to CMT, all the other basic means of fisheries conservation we use today in the West — size restrictions, gear restrictions (albeit rarely), closed seasons and closed areas (Johannes 1978).

This was probably because accessible marine resources were largely limited to shallow inshore waters in Oceania, yet were exceptionally important in island diets. The finite nature of marine resources thus apparently became obvious in many Pacific Islands long before it did among continental peoples with access to wide continental shelves and large terrestrial sources of animal protein. Survival in many of these islands has thus for centuries depended upon carefully regulated use of those resources. Not all fisheries control measures were designed with conservation in mind. But those employed for other purposes sometimes also inadvertently function as a form of conservation (Johannes 1978).

Traditional fisheries conservation measures and the conservation ethic that underpinned them are eroding in Oceania. But where they are still operating, fisheries managers should become familiar with them (Johannes 1978). Modern conservation measures that are patterned as much as is practical after traditional ones are more liable to be understood and respected by Island fishermen. Public acceptance of management schemes is especially critical to their success in Oceania because government enforcement capabilities are inadequate throughout the region. The problem is exacerbated by the very high ratio of nearshore perimeter needing surveillance to population size. Enforcement must come largely through informal social pressure and the influence of local village leaders. These are more likely to eventuate if management measures are familiar and their purposes understood.

Although Islanders often readily acquiesce verbally to outsiders' suggestions, this is often because overt disagreement is considered impolite. In fact, they resist externally imposed changes, or mould them to their own ends with as much ingenuity and energy as anyone else.

In some parts of Oceania, especially lightly populated coastal areas of Melanesia, marine resources have always existed in quantities surplus to the needs of the local populations. In at least some such areas there is little evidence of a marine conservation ethic, presumably because people have never encountered empirical evidence that their marine resources were susceptible to overexploitation (e.g. Johannes and MacFarlane, in press). If local fishermen are unaware that their resources are vulnerable to depletion this invites problems when an export market develops and places added pressure on these resources.

Traditional Knowledge

Small-scale fishermen in Oceania use a wide range of fishing gears to catch a bewildering array of species. The catch is typically landed in very small quantities at many landing sites at all hours of the day and night. From there it often goes through a variety of subsistence as well as commercial distribution channels. Fishing effort varies not only seasonally but erratically within seasons owing to the fact that, as noted earlier, fishing is seldom a

full-time occupation. Reliable data on fishing effort, catch composition and quantity, and other important statistics on which to base sound biological management are thus very difficult to obtain (see Wright 1988 for a more detailed account of such problems). It is, in fact, often quite impossible to obtain such information at costs commensurate with the economic gains that might be achieved through its use, except for a very few high-value export species such as trochus, rock lobster, shrimp or beche-de-mer.

Moreover, multispecies fisheries management theory is still in its infancy. Thus, even in cases where we have useful data, we are quite unable to manage multispecies tropical reef fisheries on an efficient scientific basis. It will be decades, if ever, before we are able to do so. Most of our management prescriptions are therefore based largely on hunches and good intentions.

One underutilised source of knowledge about local marine resources is the fishermen themselves. In some Island groups they possess encyclopaedic, practical, verifiable knowledge about their marine resources that would take tens of years and many researchers to discover independently (e.g. Johannes 1981). Fisheries managers have tended to underestimate or completely ignore such knowledge.

Whenever I work on small-scale fisheries in the Pacific Islands, I spend about 10 days with fishermen for every 2 days spent with government resource managers. Fishermen are good sources of information on many aspects of their fisheries. But, unlike typically outspoken Australian or American fishermen, they tend to be reticent and are reluctant to initiate discussions with 'officials' about their concerns. Approached sympathetically and patiently, they could be valuable sources of information for the economist, especially since more conventional sources are so meagre. Seldom do researchers think to ask them the simple question, 'what are your problems?'

Foreign Aid

The Pacific Island nations are becoming increasingly dependent upon foreign aid; most lack sufficient natural resources to support themselves in the style their Western-educated elites have come to expect. The South Pacific region receives 'the most aid, per capita, in the world, although compared with other regions the need for aid is marginal,' (Report of the Committee to Review the Australian Overseas Aid Program 1984). Overseas aid makes up more than one-half of the national budgets of such Pacific Island nations as Western Samoa, Tuvalu and Tonga. It makes up almost 90% of the budget of the Federated States of Micronesia (U.S. Dept. of State 1985).

These aid programs show little sign of achieving their ostensible aim — to assist development so as to make aid redundant. Indeed, they may function unintentionally to subtly drain away human initiative, and seem, in Oceania, to be leading to a condition of permanent dependence. Knapman (1986) notes, however, that, in contrast to the rest of Oceania 'there is a consensus that aid *might* promote growth, and therefore eliminate itself, in Papua New Guinea, Fiji, the Solomons, and perhaps Vanuatu' (emphasis added).

The desire of international development agencies to help Island countries get the most from their fisheries resources as quickly as possible has also tended to promote overcapitalisation. (The fact that Island fishermen have not eagerly embraced the capitalist work ethic has undoubtedly saved marine resources from an even greater pounding.)

Not fully appreciating the complexities of Pacific Island fisheries development and the slow pace of change in the area, aid donors sometimes try to operate according to unrealistic time frames. Greater pressure sometimes exists to develop, for example, than to obtain information on development potential. Projects may focus too narrowly on financial returns and short-term goals.

Another sobering fact for prospective aid-givers is that aid is often used to obtain more aid rather than to achieve economic self-sufficiency. Speaking of one country in the region, but describing a widespread phenomenon, Rodman (1987: 721) states, 'there is virtually no attempt on the government's part to discover whether a particular project would be able to stand on its own. Fuel subsidies, grants, loans, a favorable price at the fish market, the expertise of an expatriate volunteer all help to create an image of success for the Volunteer Fisheries Development Program. This image is, in a sense, more important than the bottom line on a realistic balance sheet, for the image of success is what attracts more aid.'

Conclusions

There are advantages in working in Island economies. The dimensions and complexities of microcosms may be more easily grasped, and some Island customs, traditions and knowledge can prove

very useful to the researcher or resource manager. But I hope I have persuaded you that development issues in Oceania are far more complex and difficult than they might at first appear.

The neatly graphed and elegant textbook objectives of fisheries management are rarely, if ever, relevant to small-scale multispecies fisheries in the region. It is difficult to visualise an econometric model or, indeed, any other quantitative model of such fisheries that contained all the variables needed to describe an effective management or development policy. Too many relevant variables are either only fuzzily quantifiable at best (e.g. social costs and benefits in societies where fish and fishing play an exceptionally important and complex role in social organisation) or impossible to quantify without impractically expensive data-gathering projects.

One aims, therefore, not for some maximum (maximum sustainable biological yield, maximum economic yield) but rather for minimising ecological, economic and social stresses, reducing conflicts between fishermen and attaining a more equitable distribution of income — in short, managing in such a way that the fisheries are 'in a less bad state' (ACMRR Working Party on the Management of Living Resources in Near-Shore Tropical Waters, 1983).

The authors of a recent review of conservation of shallow tropical marine ecosystems — all three of them biologists — have concluded that the most important research priorities are not biological, but socioeconomic (Hatcher et al. 1989). Controlling the overfishing and pollution that reduce seafood production over large areas in the coastal waters of Oceania requires first and foremost that we influence human behaviour. The Pacific Island nations badly need advisers who can provide sound economic arguments for the more efficient use of these resources in ways that are compatible with the values and perceptions prevailing in the area.

Anthropologists are increasingly focusing on the social constraints on production in Oceania. Biologists have been industrious in trying to define the biological limits of fisheries production in the region. What is lacking are people who use this and other information to explore the options, assess direct and indirect costs and benefits of various alternatives and decide what biologically, socially and politically acceptable economic alternatives are available to the fisheries resource manager.

While the resources involved are very small by world standards, the intellectual challenges this task poses are substantial. Moreover, the interdisciplinary teams so often called for in connection with resource development planning would generally be too socially disruptive — as well as too expensive — in fishing villages with populations averaging between 50 and 300. Thus the disparate threads that make up the fabric of resource management policy must often be both spun and woven by individual researchers.

To date most marine resource management advice in Oceania has come from biologists. Either this must change or fisheries biologists in the region must expand their range of vision. Their efforts to improve their performance in the region have tended to focus much more on designing more quantitatively rigorous biological data-gathering programs than on examining the other essential but often qualitative dimensions of management, including the administrative, political and social factors that are so vital in shaping realistic management options.

Anthropologists, whose knowledge, in my opinion, entitles them to a greater role in formulating fisheries policy in the region than they have so far been given, nevertheless have a contrasting blind spot. Burton et al. (1986: 266) state that 'regional analysis (of natural resource systems) requires the use of sampling and statistics, and too many ethnographically oriented anthropologists have resisted any form of quantification.' Clearly there is a niche here for economists.

Fisheries development is part of the larger process of development that is, in the aggregate, failing Pacific Islanders. For better or worse, development will continue. The 'revolution of rising expectations' has seen to that. But Islander leaders and their foreign advisers have both been slow to acknowledge the magnitude of the physical, psychological, social and environmental costs it has been exacting. Westernisation and the introduction of cash economies often bring with them obvious benefits. But throughout Oceania they have also repeatedly been followed by escalating rates of heart disease, diabetes and alcoholism (e.g. Coyne 1984), mental illness and suicide (e.g. Pacific Island Studies Program 1985), drug use and crime, as well as the erosion of traditional authority and the integrity of the traditional extended family.

Academics argue over precise mechanisms and proximate causes. But the fact remains that, in most cases, these problems increase, often dramatically,

in both space and time as one progresses from the more traditional and remoter Island communities to more Westernised and monetised ones; the trends are too consistent to be coincidental.

If development experts are to benefit Island societies, clearly they must address more seriously the problems of reducing the negative impacts of development.

If you would tackle the problems of how to make better economic use of overexploited marine resources, then Micronesia and Polynesia (and more heavily populated parts of Melanesian coastlines) offer plenty of challenge. If you prefer to work where shallow coastal marine resources remain underexploited along significant stretches of coast, then head for Melanesia. It is here in the remoter areas, where tradition remains strongest, that marine resources surplus to local needs are most often found.

But natural resources that are superabundant in local subsistence economies may quickly become limited when they become part of an export market. Export development efforts, therefore, should focus on natural resources that are not vital to traditional subsistence exchange networks; crayfish, trochus, green snail, black coral, beche-de-mer, shrimp and pearl shell are usually better targets for export than are most reef fish. (In addition, all of the former are more valuable per unit weight than reef fish, and some of them are much less perishable and thus easier and cheaper to transport).

The foreign aid-givers should be eager to hear of your plans. You couldn't do much worse than has already been done in the region. I hope you do better.

References

ACMRR Working Party on the Management of Living Resources in Near-shore Tropical Waters. 1983. Report of the ACMRR Working Party on the Management of Living Resources in Near-shore Tropical Waters. FAO Fisheries Rept. 284.

Alexander, P. 1975. Do fisheries experts aid fisheries development? Maritimes Studies in Management, 3, 5-11.

Anonymous. 1988. ICLARM Five Year Management Plan (1988-1992). Part I. Directions and opportunities. International Center for Living Aquatic Resources Management. Manila.

Ben-Yami, M. 1980. Community fishery centers and the transfer of technology to small-scale fisheries. p. 936-945 In: Symposium on the Development and Management of Small-Scale Fisheries. Section III, Proc. 19th session Indo-Pacific Fishery Commission, Bangkok, FAO Regional Office for Asia and the Pacific.

Burton, M.L., Schoeppfle, G.M., and Miller, M.L. 1986. Natural Resource Anthropology. Human Organization, 46, 261-269.

Coyne, T. 1984. The effect of urbanization and western diet on the health of Pacific Island populations. South Pacific Commission, Noumea, New Caledonia. Tech. Pap. No. 186.

Davis, S. 1984. Aboriginal claims to coastal waters in north-eastern Arnhem Land, Northern Australia. In: Ruddle, K., and Akimichi, T. (ed.) Maritime Institutions in the Western Pacific, Senri Ethnological Studies No. 17, 231-251.

Halapua, S. 1982. The Tongan Fishermen. Institute of Pacific Studies, Suva, Fiji.

Hatcher, B.G., Johannes, R.E., and Robertson, A.I. 1989. Review of research relevant to the conservation of shallow tropical marine ecosystems. Oceanography and Marine Biology Annual Reviews, 27, 337-414.

Hviding, E. 1988. Marine tenure and resource development in Marovo Lagoon, Solomon Islands. FFA Report. South Pacific Foreign Fisheries Agency, Honiara, Solomon Islands.

Johannes, R.E. 1978. Traditional marine conservation methods in Oceania and their demise. Annual Reviews of Ecology and Systematics, 9, 349-364.

1981. Words of the Lagoon: Fishing and Marine Lore in the Palau District of Micronesia. Berkeley, University of California Press.

Johannes, R.E., and MacFarlane, W.J., in press. Traditional Fishing in Torres Strait Islands. Australian Government Printing Office.

Knapman, B. 1986. Aid and the dependent development of Pacific island states. Pacific Island History, 21, 139-152.

Lawson, R.M. 1980. Development and growth constraints in the artisanal fisheries sector in island states. In: R.T. Shand (ed.), The Island States of the Pacific and Indian Oceans: Anatomy of Development. Development Studies Centre Monograph No. 23, Canberra, Australian National University, 61-85.

MacLean, J. 1988. Thanks for using Naga. Naga, ICLARM Quarterly, July 1988, 16-17.

Meltzoff, S.K., and LiPuma, E.W. 1983. A Japanese fishing joint venture: worker experience and national development in the Solomon Islands. International Center for Living Aquatic Resources Management, Tech. Rept. 12 p. 35.

Pacific Islands Studies Program. 1985. Culture, Youth and Suicide in the Pacific. Papers from an East-West Center Conference. Working Papers, Pacific Islands Studies Program. Honolulu, Hawaii.

Robinson, M.A., and Lawson, R. 1986. Some reflections on aid to fisheries in West Africa. Marine Policy, 10, 101-110.

Rodman, M.C. 1987. Constraining capitalism? Contradictions of self-reliance in Vanuatu fisheries development. American Ethnologist, 14, 712-726.

Sahlins, M.D. 1974. Stone Age Economics. London, Tavistock.

South Pacific Commission. 1988. Proceedings of the Workshop on Pacific Inshore Fisheries Resources, Noumea, New Caledonia, South Pacific Commission.

Smith, I.R. 1979. A research framework for traditional fisheries. International Center for Living Aquatic Resource Management, Studies and Reviews, No. 2.

Useem, J. 1945. The changing structure of a Micronesian society. American Anthropologist, 47, 567–588.

U.S. Congress, Office of Technology Assessment. 1987. Integrated Renewable Resources Management for U.S. Insular Areas. OTA-F-325, Washington, D.C., U.S. Government Printing Office.

U.S. Department of State. 1985. Trust Territory of the Pacific Islands, 38th Annual Report to the United Nations. Washington, D.C., U.S. Department of State.

Wright, A. 1988. Fisheries research in the south west Pacific: a summary of some of the problems. In: Proceedings of the Workshop on Pacific Inshore Fisheries Resources, Noumea, New Caledonia. South Pacific Commission.

Wright, A. and Kurtama, Y.Y. 1988. Man in Papua New Guinea's Coastal Zone. p. 411–446 In: Ruddle, K., Morgan, W.B., Pfafflin, J.R. (ed.) The Coastal Zone: Man's Response to Change. New York and Chur, Harwood Academic Publisher.

Economics in Aquaculture and Fisheries: Selected Experiences of the Pacific Islands

K. Roger Uwate[1]

Abstract

Economic development is a priority of Pacific Island nations. Since fisheries is the primary resource of these Islands, its rational development and management are of paramount importance. Aquaculture is closely tied to fisheries development and management.

Socioeconomics is essential for efficient management and effective development of fisheries and aquaculture in the Pacific Islands region. The objective of this paper is to increase awareness of this topic through the presentation of four case studies.

By addressing socioeconomic issues, successful management and development of fisheries and aquaculture in the region may be realised. When they are ignored, project failure too often results. This wastes time and resources in Island nations that can ill afford the luxury of inefficient management and ineffective development of their primary resource.

Introduction

THE application of socioeconomics is essential for efficient management and development of fisheries and aquaculture. This is especially true in the Pacific Islands region.

With the emergence of the Pacific Islands region as independent nations, national economic development is now a priority of Island governments. Most Pacific Islands, in particular atolls, have limited land-based resources, but extensive marine resources. As such it is logical that economic priorities be focused on aquaculture and fisheries development issues.

In addition, population increases as well as introduction of modern fishing technology have, in some cases, resulted in overexploitation of inshore resources, especially in urban areas. Management of these resources is becoming a necessity.

Before proceeding, it should be noted that the definition of economics in the academic and applied arenas may be different. Applied economics often includes areas such as marketing, finance, management, as well as accounting. In an academic setting, these are usually reserved for the business department.

It would seem that one objective of this workshop is to bring about increased awareness among the Pacific Island representatives here of the role of economics in fisheries and aquaculture. This has been taken as the objective of this paper. The vehicle used here for accomplishing this objective is by selected case studies.

Four case studies are presented to illustrate positive applications of economics in fisheries and aquaculture in the region. They cover the following topics: (1) economics in fisheries management; (2) fish marketing; (3) economic justification for funding; and (4) economics in aquaculture planning.

[1] Senior Economist, Forum Fisheries Agency, PO Box 629, Honiara, Solomon Islands. The views presented in this paper are those of the author and do not necessarily reflect those of the Forum Fisheries Agency.

Case 1. Economics in Fisheries Management

Most fisheries managers are biologists by training, and have little background and interest in economics. The focus in fisheries management is therefore often limited to the concept of maximum sustainable yield.

Fisheries management in the Pacific Islands follows a similar bias. Cases of economic considerations in development of fisheries management policy are limited.

One example of the application of economics in fisheries management is the trochus fisheries in Yap State, Federated States of Micronesia. The case is as follows.

In the Code of the Federated States of Micronesia, Title 23, Chapter 1 on Marine Species Preservation, regulations are provided for management of trochus harvest (see Yap MRMD 1986a). A minimum size limit of 7.62 cm (diameter at base) is stated, based on McGowan (1958).

In 1986, the Marine Resources Management Division of Yap State initiated two surveys on trochus (Yap MRMD 1986b). The first was to assess the trochus resources of Yap Proper. The second survey was to obtain baseline information regarding the international market for trochus.

In the stock assessment survey, populations were estimated based on a series of transects (Yap MRMD 1986b). Results indicated mean trochus density and shell size frequency distribution. Estimates were made regarding the standing stock and its size distribution.

In the market survey, international buyers were identified and queried as to the nature of the trochus market (Yap MRMD 1986b). Responses indicated that: (1) there was some preference for smaller sized shells; (2) shell size affected price; (3) old, dead, wormed, or sunburnt shells were not desired; (4) shell quality affected price; and (5) shell quality was determined by sending samples to the buyer for analysis.

A short literature review was also conducted on trochus (Yap MRMD 1986b). Published information indicated that: (1) trochus reach sexual maturity at shell diameter of about 6.35 cm; (2) trochus can reach maturity in the wild at about 1.5 years; (3) large trochus produce significantly more eggs than small trochus; and (4) larger, older trochus have a greater chance of being wormy than smaller, younger ones.

From this information, a management program was developed that trochus harvest be limited to 7.62–10.16 cm base diameters at widest point (see Yap MRMD 1986b). The rationale here was that larger trochus were usually wormy with low market value while they produce more eggs. Trochus reached maturity before 7.62 cm shell diameter. Reproduction was therefore possible prior to exposing this size of trochus to harvest. In addition, the season was only opened for 1 month/year. This allowed fast-growing undersized trochus to grow beyond the 10.16 cm maximum size prior to the following season, and thus escape harvest.

In this case market considerations were included in determining the management strategy of this fisheries resource.

As a postscript to this case, in the 1986 trochus season, harvest was monitored at the exporter level (Yap MRMD 1986c). Length frequency data were obtained and compared to legal size limits. Of the three exporters buying trochus shells, two followed the size regulations, but the third had almost 70% of shells oversized. The harvest regulations made did not cover exporters, so there was no legal recourse in 1986.

In 1987, Yap MRMD conducted another trochus stock assessment, and provided recommendations on the 1987 season (Yap MRMD 1987a). This time the regulations governing trochus harvest were expanded to include exporters of trochus shells. In 1987 trochus harvests were again monitored (Yap MRMD 1987b). Purchases were by the only exporter which were closely monitored. Length frequency data from this exporter indicated that almost 100% of shells were within legal size limits (Yap MRMD data files).

Case 2. Fish Marketing

In many fisheries development projects in the Pacific Islands, it is assumed that a certain species of fish can be exported for sale at distant markets. For many species this is true. However, it can also be important to examine the target market to determine the acceptability of a particular fish to that export market. Form and state, as well as size of fish, may be relevant considerations here.

This case study relates to the Temaiku milkfish farm in Tarawa. In 1973, a project was initiated in Tarawa, Kiribati, to investigate the rearing of milkfish (*Chanos chanos*) for consumption and as live bait for tuna fishing (see Uwate et al. (1984) for background history). Milkfish culture was initiated and a farm was developed. The facility currently has

80 ha of ponds and produces between 10 and 20 t of milkfish annually (Uwate et al. 1986).

This facility currently produces milkfish for bait for the pole and line fleet of the Te Mautari, the national fishing company (Uwate and Teroroko 1986). In addition, milkfish that grow beyond bait size are sold as food fish either locally or exported to Nauru.

The Temaiku Farm shipped milkfish regularly to Nauru (Uwate and Teroroko 1986). In 1985 direct exports were almost 7000 kg. Private individuals in Tarawa purchase fish from Temaiku and ship them to Nauru. The price for food-sized milkfish was $A1.32/kg. When the Temaiku farm shipped fish, there was a small fee for packaging and handling. In addition, air freight charge was $A0.35/kg.

In 1986, UNDP sponsored a short market survey consultancy to Nauru (Uwate and Juario 1986). Results indicated that milkfish sold in Nauru from Christmas Island were typically large (2–4 kg/fish) and tough; fish from Guam, Philippines, and Taiwan were juicy with abdominal fat and were of medium size (about 3 fish/kg); Tarawa fish had no abdominal fat and were small (4–5 fish/kg). Tarawa-cultured milkfish were not preferred by Nauruans as they were too small and had low oil content.

The retail price of milkfish in Nauru ranged from $A2.50 to $A8.50/kg for whole fish (Uwate and Juario 1986). Tarawa-cultured milkfish commanded a price at the lower range. The recommendations from this market survey were to export larger milkfish (with body fat) and to increase the farm-gate price to about $A2.50/kg.

In late 1986, the farm manager began selectively exporting larger fish (T. Teroroko, Kiribati Fisheries Division, January 1988 pers. comm.) In addition, the farm-gate price for exported milkfish was increased from $A1.32/kg to $A2.50/kg for whole fish. Despite these price changes, the export volume to Nauru remained constant. The net result of doubling farm-gate price was that farm revenues from exported fish doubled.

It should also be noted that fish are grown extensively (Uwate et al. 1986). No feed is used. As such, incremental costs for growing fish longer (and larger) are minimal.

In this case, some basic understanding of the target market resulted in substantial gains in revenues to the operations.

As a postscript to this case, in 1988 the air link with Nauru was lost due to strikes and problems with the safety certification (T. Teroroko, November 1988 pers. comm.). With the loss of this air link, milkfish exports have been terminated.

Interest has been expressed by the Marshall Islands about the export of milkfish there.

Case 3. Economic Justification for Funding

Economics can be a tool for justifying a fisheries development project. This is often the case as fisheries projects must often compete with other economic development projects for limited resources. In addition, when fisheries development projects compete with each other for funding, economic justification can be instrumental in the funding selection outcome.

This case relates to the issue of fish aggregation devices (FADs).

For several years, the U.S. has supported fisheries development activities in affiliated Pacific Islands through the Saltonstall-Kennedy Grant Program (S-K Program). Funds were channelled through the Pacific Fisheries Development Foundation (PFDF). PFDF assists affiliated Pacific Islands develop proposals and compete for S-K funds.

From about 1984–85, the S-K Program supported FAD projects in American Samoa and the Federated States of Micronesia (PFDF, 1986 pers. comm.). In 1986 and 1987, fisheries officers in affiliated Pacific Islands were informed by PFDF that the S-K Program would not fund any additional FAD projects.

In 1985 to 1986 several economic analyses of FADs in the Pacific Islands region were completed (see Samples and Sproul 1985; Samples 1986; Uwate 1986). Samples and Sproul (1985) provided a bioeconomic model to illuminate biological interdependence between fishing FAD and nonFAD areas.

The socioeconomics of FADs were appraised by Samples (1986) based on a survey of FAD users in Hawaii. It was estimated that the willingness to pay for FADs was more than the average annual program costs.

In 1986, a paper was submitted to PFDF on the economic performance of FADs in Yap, Federated States of Micronesia (Uwate 1986). Economic analysis indicated that fishing FAD areas resulted in higher catches and net revenues than other methods used including fishing nonFAD areas. It appeared that the incremental benefit of fishing FAD areas could offset construction and deployment costs within 3–4 months (about 100

trips). Previous to this analysis, the National Marine Fisheries Service (NMFS) had insisted that, in order to be economically viable, FADs should have a life of at least 2 years.

In 1987, contrary to recommendations from NMFS, Palau submitted a proposal for FAD development (T. Paulis, Chief Palau Marine Resources, October 1988 pers. comm.). Despite repeated negative advice from NMFS, it was funded.

As a postscript to this case study, 1988 guidelines for S-K funding priorities were published in the Federal Register (1988). The following was indicated:

> "New information and data on FADs indicate that improvements in cost effectiveness can be made over earlier mooring design and deployment strategies. Therefore, proposals related to FADs will be considered, particularly those that will investigate FAD material, design and productivity."

Without being privy to the inner workings of the U.S. Government, it is difficult to show a direct cause and effect between these economic analyses and the shift in U.S. funding priorities. However, it appeared that new information, which would include the above-mentioned economic studies, caused the NMFS to reassess and change its position regarding support of FAD projects in the Pacific Islands region.

Case 4. Economics in Aquaculture Planning

An integral part of planning development is economics. Without economic and market information, expectations for development may not be realistic. In this case, aquaculture development in Guam is used to illustrate market and economic consideration in its development.

Beginning in the early 1970s, Guam took steps to develop aquaculture. The University of Guam, through its marine laboratory, began culture trials (FitzGerald 1982a). Potential sites for aquaculture were identified (Ikehara 1973). Aquaculture trials were also initiated by the Guam Division of Aquatic and Wildlife Resources (FitzGerald 1982a, 1982b).

The potential for aquaculture in Guam was assessed (FitzGerald 1975). Its impact on Guam's coastal waters was also identified (FitzGerald 1977). Resource limitations (e.g. water, suitable land) and constraints were identified (see also Guam Department of Commerce 1978).

In 1979, a feasibility study was completed on a multiuse hatchery for Guam (Aquatic Farms 1979). Lack of a hatchery was identified as a limiting factor to aquaculture development in Guam.

In 1982, an aquaculture development plan was prepared for Guam (see FitzGerald 1982a). The plan provided a blueprint for aquaculture development in Guam. It included: (1) a review of aquaculture activities in Guam; (2) identification of development potentials; (3) identification of institutional organisations; and (4) formulation of a development and implementation strategy.

The major constraint to aquaculture development in Guam was lack of seed stock (FitzGerald 1982a). In 1985, the Government of Guam acquired a hatchery (W. FitzGerald, February 1989 pers. comm.). Operating funds were obtained in 1987, and in 1988 the hatchery began providing prawn postlarvae to local farmers.

The need for market information was identified in the 1982 plan (see FitzGerald 1982a). A baseline market survey was completed in 1983 (see Myers et al. 1983). Total local consumption was estimated at 488 t with retail value of US$2.6 million. Local landings accounted for 31% of local consumption. Aquaculture produced about 14.4 t.

Extension assistance was provided by the University of Guam (Guam Department of Commerce 1982). In 1982, it produced a farm management manual for aquaculture farmers (Barcinas 1982).

In addition, the need for economic analysis of culture systems was identified in the 1982 plan (see FitzGerald 1982a). Comparative economics were completed by FitzGerald (1988, 1989). Economic analysis centred around four primary species, the freshwater prawn, milkfish, Asian catfish, and a hybrid tilapia. Results indicated that monoculture of the Asian catfish showed greatest return on capital.

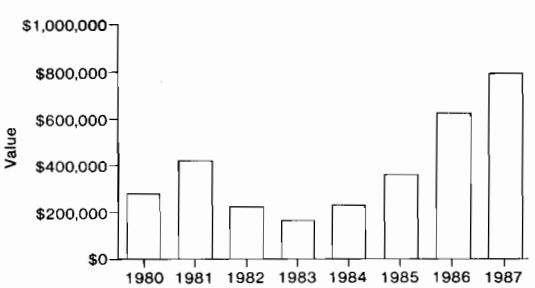


Fig. 1. Value of Guam Aquaculture Production (source: W. FitzGerald, Jr., Guam Department of Commerce, pers. comm., February 1989).

By knowing Island resource limits, the market, and comparative economics of different culture systems and species, Guam fish farmers are in a good position to develop sustainable commercial aquaculture operations (Fig. 1). The Government of Guam has ensured that necessary baseline market and economic information is available to farmers. In addition, it provides, through the University of Guam, extension assistance to local fish farmers.

Conclusions

The examples provided above represent diverse areas where economics principles have been successfully applied to development and management issues of fisheries and aquaculture in the Pacific Islands region. It should be noted that just because economic issues are addressed, this does not necessarily guarantee long-term success. The case in point is the export of milkfish from Kiribati to Nauru. There are other factors that may come into play (such as the airline strike).

By addressing economic factors, the probability of successful management and development of fisheries and aquaculture in the region should be greatly increased.

If economic factors are ignored, then there is a real chance that the management or development program will not succeed. There are too many examples of so-called fisheries development activities in the region that were initiated in economic ignorance. Most failed or are doomed to failure. This is a waste of time and resources. Emerging nations, such as those in the Pacific Islands region, can hardly afford the luxury of inefficient management and ineffective development of their fisheries and aquaculture resources.

Acknowledgments

I wish to thank Dr Y. Shang, Department of Agriculture and Resource Economics, University of Hawaii, and Tukabu Teroroko, Acting Chief, Kiribati Fisheries Division, for reviewing this paper and making valuable suggestions for improvement. In addition, I would like to acknowledge William J. FitzGerald Jr., Guam Department of Commerce, for assistance in compiling the case study on Guam aquaculture planning.

References

Aquatic Farms. 1979. Multi-use options for a prawn hatchery on Guam. Project No. 07-6-02028. Department of Commerce. Government of Guam. August 1979. 60 p.

Barcinas, J. 1982. Guam farm record book. University of Guam. College of Agriculture and Life Sciences. Coopertive Extension Service.

Federal Register. 1988. Notices. 28 March 1988, 53(59), 10046.

FitzGerald, W.J., Jr. 1975. A study to determine the aquaculture potentials of Guam. Guam Division of Fish and Wildlife. National Marine Fisheries Service, Washington, D.C. NOAA-NMFS-4-23-D. 17 p.

1977. Aquaculture and its potential environmental impact on Guam's coastal waters. Volume 1. Bureau of Planning. Government of Guam. Agana, Guam. 57 p.

1982a. Aquaculture development plan for Territory of Guam. Department of Commerce, Government of Guam. 182 p.

1982b. An introduction to aquaculture on Guam: prospects, permits and assistance. Guam Coastal Management Program. Bureau of Planning. Government of Guam.

1988. Comparative economics of four aquaculture species under monoculture and polyculture production in Guam. Journal of the World Aquaculture Society, 19(3), 132-142.

1989. Analysis of the financial return from aquaculture under different culture systems in Guam: a decision making tool for management. University of Guam Marine Laboratory, Technical Report No. 91. 35 p.

Guam Department of Commerce. 1978. The five-year economic development strategy. Territory of Guam. Economic Planning Division. Bureau of Planning. Government of Guam. August 1978.

1982. Guam annual economic review 1982. Government of Guam.

Ikehara, I.I. 1973. Development of Guam's commercial fisheries potential. Guam Division of Fish and Wildlife. Prepared for National Marine Fisheries Service. Com.-73-110609. July 1973.

McGowan, J.A. 1958. The trochus fishery of the Trust Territory of the Pacific Islands. Report to the High Commissioner, U.S. Trust Territory of the Pacific Islands. 46 p.

Myers, R.F., Callaghan, P., and FitzGerald, W.J., Jr. 1983. Market for fresh or frozen whole fish in Guam. University of Guam Marine Laboratory, Technical Report No. 84. 50 p.

Samples, K.C. 1986. A socioeconomic appraisal of fish aggregation devices in Hawaii. Sea Grant Marine Economics Report. UNIHI-SEAGRANT-ME-86-01. 54 p.

Samples, K.C., and Sproul, J.T. 1985. Fish aggregating devices and open-access commercial fisheries: a theoretical inquiry. Bulletin of Marine Science, 37(1), 305-317.

Uwate, K.R. 1986. Yap State fish aggregation devices (FAD): an analysis of catch statistics. Marine Resources Management Division, Yap State Department of Resources and Development, Colonia, Yap, Federated States of Micronesia. Submitted to Pacific Fisheries Development Foundation, Honolulu, Hawaii. 22 p.

Uwate, K.R., and Juario, J.V. 1986. The Nauru market for milkfish and other fishes: a preliminary examination. Submitted to Fisheries Division, Ministry of Natural Resources Development, Republic of Kiribati. 18 p.

Uwate, K.R., Juario, J.V., and Teroroko, T. 1986. An assessment of the Temaiku Bait Fish Farm in Tarawa, Kiribati. Submitted to Fisheries Division, Ministry of Natural Resources, Republic of Kiribati. 53 p.

Uwate, K.R., Kunatuba, P., Raobati, B., and Tenakanai, C. 1984. A review of aquaculture activities in the Pacific Islands region. Pacific Islands Development Program, East-West Center, Honolulu, Hawaii. 475 p.

Uwate, K.R., and Teroroko, T. 1986. Market considerations for bait and food fish products of the Temaiku Fish Farm. Submitted to Fisheries Division, Ministry of Natural Resources Development, Republic of Kiribati. 39 p.

Yap Marine Resources Management Division. 1986a. Yap State Marine Resource Management Plan. Department of Resources and Development, Yap State, Federated States of Micronesia. 30 p.

1986b. Trochus: Yap Proper stock assessment and prefactory market study. Yap State Department of Resources and Development. Colonia, Yap, Federated States of Micronesia. 23 p.

1986c. Yap trochus sales: 1986. Yap State Department of Resources and Development. Colonia, Yap, Federated States of Micronesia. 14 p.

1987a. Yap Proper trochus stock assessment: 1987. Yap State Department of Resources and Development, Federated States of Micronesia. 7 p.

1987b. Marine Resources Management Division: FY-1987 Annual Report. Yap State Department of Resources and Development, Colonia, Yap, Federated States of Micronesia. 51 p.

Pacific Giant Clams and Their Products: An Overview of Demand and Supply

Clem Tisdell[1]

Abstract

Due mainly to overharvesting, the world's natural stocks of giant clams have been seriously depleted and most species are now listed as endangered species under CITES (The Convention on International Trade in Endangered Species). There is a perceived shortage of clam supplies in the Pacific Islands and in Chinese areas such as Taiwan and Hong Kong. The development of techniques for the aquaculture (mariculture) of giant clams, however, raises the possibility of a new source of supply. In this paper, the type of clam products that are likely to be in demand are discussed, elements that may influence these demands are identified and factors that are likely to determine supplies are highlighted. It is anticipated that future ACIAR-supported research will enable the economic prospects and possible industry pattern of development of Pacific giant clam mariculture to be pinpointed more precisely.

Introduction

PACIFIC giant clams are marine bivalve molluscs. There are seven species in existence and they are confined in their natural distribution to the warmer waters of the Pacific and Indian oceans. In fact, the natural distribution of some of the largest species is even more restricted, being confined to tropical waters bounded on the eastern side by Fiji and Tonga and bounded on the western side by northwest Australian waters and those of Indonesia (Munro and Heslinga 1982). Natural stocks of giant clams, particularly of those species which grow to the largest size, have been seriously depleted throughout their natural ranges, principally as a result of harvesting. Increased harvesting pressure came from three sources: (1) greater subsistence and domestic consumption in the countries with natural stocks; (2) harvesting by foreign vessels (often Taiwanese vessels but sometimes Australian) for export of giant clam muscles principally to Taiwan; and (3) involvement of domestic import-export firms (very often traders and processors playing an important middleman role) in the export of giant clam products.

Because of the serious depletion of natural stocks of giant clams, many governments in the Pacific have prohibited or restricted the export of giant clam products. Furthermore, most species have now been listed under CITES. This means that signatories to this Convention should prohibit the export or import of the species concerned. But not all countries are signatories to the Convention, a signatory can exclude certain species, and, of course, the law can be circumvented in other ways (e.g. by deception or vague labelling).

Against this background of dwindling natural stocks, scientists have developed techniques to culture giant clams (Lee 1988). Papers given at the ACIAR Workshop on Giant Clams in Townsville, 18–22 April 1988 (Copland and Lucas 1988), provide a useful overview of current scientific status of clam farming (see also Heslinga and Fitt 1987). Clam farming technology has advanced rapidly in recent years. Major scientific research centres are located at the Micronesian Mariculture and Demonstration Center (MMDC) in Palau, and at James Cook University in northern Australia.

[1] Department of Economics, University of Queensland, St Lucia, Qld 4067, Australia.

Research is also being conducted at other locations. For example, in the Philippines at both Silliman University and the University of the Philippines, in Fiji by the Department of Primary Industry, in Papua New Guinea at the University of Papua New Guinea and in Solomon Islands by the International Center for Living Aquatic Resources Management (ICLARM). Several governments are interested in the prospects for giant clam mariculture as an industry for development and a number of firms, including Australian firms, have commenced pioneering efforts in the commercial development of giant clam farming. The Australian Centre for International Agricultural Research has been and is a major financial sponsor of scientific and technological advance in this area, principally through its commissioning of research with and through James Cook University.

The mere fact, however, that it is technically and ecologically possible to cultivate Pacific giant clams does not mean that it is economic to do so. Market prospects, production economics and the social structure in a country, including arrangements relating to property rights, may be such as to prevent economic success. Whether or not giant clam mariculture will be economically successful and where is unknown at this time. However, there are definite prospects for its economic success (Tisdell 1986; Tisdell and Menz 1988). With this in mind, ACIAR has just (March 1989) commissioned a project, 'Economics of Giant Clam (Tridacnid) Mariculture,' with the University of Queensland and under the leadership of the author to 'provide guidance on market prospects for giant clams and trading arrangements, production economics and supply, marine property rights as these affect the economics of giant clam mariculture, and the value of giant clam mariculture in development as a component of productive possibilities in less developed countries in the Indo-Pacific region, especially South Pacific countries.'

The Center for Tropical and Subtropical Aquaculture located in Hawaii is also to commence a project developing marketing strategies for Pacific giant clams and examining markets for them. This marketing project will complement the ACIAR-funded socioeconomic project.

Demand for Pacific Giant Clams

To predict the demand for the economic use of giant clams and the supply likely to be forthcoming from mariculture is a very difficult problem. This is because, on the demand side, there is no longer an international market of significance for giant clams from natural sources. Also, supplies from the wild have virtually dried up because of depletion of stocks, restrictions on harvesting and/or on export by governments. The application of CITES to most species of giant clam is also a contributing factor. Furthermore, harvest from the wild usually involved larger and older clams and the products supplied by these may be somewhat different to those which it is economic to supply from cultured giant clams. Therefore, markets which have existed in the recent past or which exist now in a restricted form may be a poor guide to the demand for maricultured clams. Nevertheless, past and existing attenuated markets do give some guide to possible market outlets for giant clams.

The meat of the giant clam can be divided into two components: (1) the adductor muscle, and (2) the mantle. The muscle is in greatest demand and, in the past, Chinese demand has principally been for the adductor muscle which has to be separated from the mantle. The adductor muscle appears to be relatively small in young clams and it may not pay to separate it from the mantle. We cannot *assume* that the market value (price) of the adductor muscle is linearly related to the weight or size of the muscle (cf. Munro 1985). Evidence needs to be obtained about the relationship. Not only the muscle but also the mantle of giant clams is consumed by Pacific Islanders. A demand exists for it at least in the Pacific Islands.

For larger clams, market potential exists for both the adductor muscle and the mantle. However, the possibilities for commercially marketing these items are limited because of transport time. They can, however, be chilled, frozen or preserved in other ways. For example, in Fiji, Feeders in the past traded in frozen clam meat. The adductor muscles were separated from the mantles. The muscles were packed in medium-sized cardboard boxes and frozen for export principally to Australia for reexport to Taiwan. The net weight of the carton was about 10 kg. The mantles were packed in blister packs and frozen for supply to retail outlets (supermarkets) in Fiji.

The product may also be preserved in other ways. In Micronesia, for instance, dried sticks are formed from it, and it is eaten in a similar way to 'jerky' or 'biltong.' Other low-cost methods of preserving it for at least a short period of time may exist. For

example, meat of giant clams is reported to be exported from Tokelau to Samoa to friends, etc., in barrels and these clams appear to withstand a journey of a few days. Also, some shipment in a similar form has been reported to take place in Tuvalu from the southern islands to Funafuti by plane.

The meat of the clam can be consumed in either cooked or raw form. Usually, but not always, when it is consumed in raw form it is marinated in lime or lemon juice. Westerners may find that the mantles of older clams have a 'strong taste' from the algae present. This may be disguised by making curried clams.

Apart from the direct table use of the clam meat, it is reported to have been used in other ways. One exporter from Solomon Islands claimed in the past to have exported clam mantles to SAFCOL which in his view resold it for use as a flavouring for soups. Clams are also believed by a number of Chinese to have aphrodisiac properties, and I have had a report from a Filipino that a number of Filipinos believe that it is useful for those infected by malaria to eat it.

At present, the period of time for which it is likely to be economic to hold maricultured clams before marketing or harvesting them is uncertain. This will be influenced by discount rates, growth rates of clams with time, additional costs of retaining clams, mortality rates and whether or not a price premium applies to products from older clams. Present indicators, however, are that a total cultivation period before harvest of not more than 5 years is optimal. It is even possible that harvest at approximately 2-3 years is optimal.

This period of cultivation would be similar in length to that for oysters. At this stage, giant clams of the *gigas* species are 'plate-sized.' They may be served in the shell raw (with condiments) and appear to lend themselves to inclusion in Japanese cuisine (see Anon. 1988). (At this age, the clams are quite immature and there is little point in separating the adductor muscle from the mantle.) In order to tap this potential market, the clams should desirably be kept alive until they are required for the preparation of a dish. There may be a market for clams for *sashimi*-style dishes amongst Japanese tourists to countries where clams are cultivated and there may be scope for air-freighting of live young clams to Japan to satisfy possible demand there. However, *many* Japanese have no knowledge of giant clams (Dawson 1986). So there is not a ready-made market in Japan. But in the south of Japan, especially in the Okinawa area, there appears to be some knowledge of and consumption of giant clams (Yamaguchi, pers. comm. 1988).

The market for small-sized clams for consumption needs more investigation. Also, there is a need to consider the minimum age that a clam needs to reach before it is economic to freeze or chill clam meat for *resale* and/or separate the adductor muscle from the mantle. Some questions that need to be considered in relation to the final market for clam meat are: Will it be limited principally to restaurants and hotel trade? Is there scope for its sale by specialised seafood retailers? Is there a prospect of its sale in supermarkets and what type of product is likely to be needed for this trade?

Shells of clams are also a marketable product, and in the past have been traded internationally. These are often sold by shell shops at beach locations whether or not clams are indigenous to the area. The Philippines was a considerable centre for export of these shells to Australia, Japan and the USA. Evidence from the Philippines indicates that the value of the shells often exceeded the price obtained for the meat (Juinio et al. 1986). The value of a shell can be expected to depend on such factors as its conformation, colouring and size. In the commercial farming of giant clams and in selecting breeding stock, attention should be given to the possible value of shells as well as meat. The market for shells, although valuable, may be more limited in size than the potential market for clam meat.

Markets also exist for live clams. A market exists in the USA for giant clams suitable for saltwater aquariums. This market is being tapped by the MMDC. Although this could be a significant outlet, the size of market will be limited (e.g. would be at least constrained by the number of saltwater aquariums).

The development of giant clam mariculture will also result in a market for live clams used in the industry. A developing market already exists for 'seed clams,' that is small clams from nurseries suitable for ocean grow-out or further husbandry prior to final sale. One expects also, if the industry becomes established, that a market will develop in breeding stock. In due course specialisation in production may occur (e.g. some firms in the giant clam farming industry may specialise in the breeding and raising of seed clams, whereas others will be specialised in the ocean grow-out of giant clams).

Existing data on patterns of consumption of giant clam products (now and in the recent past) are

extremely limited and often unreliable. Furthermore, in so far as they relate to giant clams harvested from the wild, they may give a misleading impression of the demand for maricultured giant clams because the size composition of the harvest may be different. Furthermore, consumption of giant clam meat has been declining because of reduced availability of supplies. This means, in some regions, that inhabitants who once were familiar with clam meat no longer know it and in other regions the inhabitants have not been able to experience it. Thus to a large extent the sale of maricultured giant clam products in international markets may hinge upon the opening up of new markets and reestablishing demand. But, of course, there are still areas in the Pacific Islands where current knowledge of and consumption of giant clams continues to take place especially in subsistence communities.

Supply of Pacific Giant Clams

The future supply of giant clams for human use and consumption depends primarily on the success or otherwise of giant clam farming. Natural stocks, except in Australian waters, are very low and recovery of populations by natural recruitment uncertain.

A number of factors can be expected to influence the supply of farmed clams. These include economic, ecological and social factors. Ecological requirements for giant clam culture include salty, clear, warm water either in the intertidal zone or not so deep as to interfere with penetration of sunlight. The availability of sunlight is important to the growth of giant clams since they live in a symbiotic association with algae, zooxanthellae, in their mantle. The waters in and around tropical coral atolls are ideal for giant clam production. Water near river outlets is usually unsuitable because of the occurrence of 'freshes' in the environment and, in many cases, the presence of sediment.

The extent to which giant clams can be grown successfully outside their known natural range is unclear. Many species which occur in Australia and the Pacific Islands to the north of Australia are not present in the West Pacific (e.g. in the Hawaiian Islands or Samoa). Furthermore, giant clams do not occur in the Atlantic Ocean. This raises the question of whether they can be successfully translocated and, from an ecological point of view, whether this is desirable. Already attempts are being made to introduce species of clams into new environments, which appear to be ecologically suitable for them but are beyond their known natural range. Possibly they can be farmed successfully in the Western Pacific and even the Caribbean.

It might also be noted that some areas in the Pacific which were once ecologically suited to the growing of giant clams are no longer suitable for the purpose. This is because of the increase in marine pollution caused by industrial, urban and economic growth (e.g. in the Philippines, Thailand and Indonesia, especially Java). In some cases too, the clearing of the land for agriculture has affected river runoff and resulted in increased marine sedimentation. Pollutants from urban, mining and industrial growth can involve heavy metals, sediments and sewerage, all of which have a serious impact on the survival, growth and acceptability of giant clams for human consumption.

Australia has a large area in the north suitable for the farming of giant clams and most of the Islands in the Southwest Pacific have substantial areas suitable for this purpose. Pollution pressures on these areas are less than in Southeast Asia.

However, economic success depends upon much more than biological possibilities. It is influenced by a whole range of factors which determine the prices received by clam farmers and the costs of their production. In addition, the nature of property rights and of social arrangements in relation to production have a bearing on economic success. Where marine property rights are uncertain or poorly defined or costly to enforce, there is little incentive to cultivate clams, since cultivators may not reap the rewards of their efforts. In the Pacific Islands, reef areas adjoining villages are *normally* at least de facto the property of each adjoining village. Collective rules apply to the use of the reef by villagers. The property situation is one of *rerum communis* rather than *rerum nullium*. It is necessary to study these arrangements in detail to determine areas in the Pacific where social and property rights arrangements are likely to be conducive to the cultivation of giant clams, either for subsistence use or for marketing. Furthermore, are there areas in the Pacific where private foreign investment in the development of giant clam farming is likely to be a commercial success and where are they located? What types of business arrangements may be most successful (e.g. joint ventures)?

Giant clam farming has been seen as a possible useful productive component in the development of atoll economies in the Pacific. It undoubtedly has

potential in this regard, especially to supplement local diets. But whether it will be able to support an export industry or a substantial export in such countries is quite uncertain. Poor infrastructures, high transport costs and infrequent transport departures may militate against this (e.g. in an atoll country such as Tuvalu). High quality of product and freshness needs to be maintained for some markets (e.g. the potential Japanese market for young live clams). In fact, Australia may be much better placed in terms of its transport system and technology to meet this demand than the Pacific Islands. Southeast Asian countries would also have the advantage of proximity, and regular plane and other connections with potential international markets. In the past, however, the large Pacific Islands have successfully exported frozen giant clam meat (e.g. Fiji, Papua New Guinea and Solomon Islands). So presumably if clams can be grown to a size sufficiently large to warrant freezing this will continue to be a possible method of export. There may indeed be some international specialisation by countries in the supply of giant clams or giant clam products with different characteristics.

Concluding Observations

It is likely that a market will develop for maricultured clams. Already a market exists in the aquarium trade and is being supplied with such clams. To the best of my knowledge, supplying this market is a successful commercial venture on the part of MMDC. A market can also be expected to develop for farmed clams for use in the restaurant and hotel speciality food trade. One can easily see giant clam dishes being consumed as special items at tourist resorts in places such as Cairns or in Hawaii where some tourists are prepared to pay a premium for exotic dishes. Indeed, the CTSA (Center for Tropical and Subtropical Aquaculture) will be exploring the scope for this possible market outlet in Hawaii. But on the surface this is a small or speciality market. The scope for developing and supplying wider markets has yet to be determined. Much may depend in developing countries on the way in which the product is promoted and presented. One should not underestimate the scope for introducing new products in developed countries. (An interesting development at some tourist resorts in Queensland is the sale of crocodile burgers. These are expensive but there is a demand for them on the part of adventurous holiday makers.)

Clearly, the economic success of giant clam farming will depend on many factors, and it will be impossible to predict precisely the development of the industry. But the economic project which is now commencing and which is to be supported by ACIAR and the marketing project being funded by CTSA should help to bring a realistic economic perspective to bear on this development. Hopefully, the results will provide a guide to the development of the industry and will be of value to producers and firms as well as governments interested in the development of the industry.

References

Anon. 1988. Wafu Salad a Hit in Japanese Restaurant. The MMDC Bulletin, June, 2.

Copland, J.W., and Lucas, J.S. 1988. Giant clams in Asia and the Pacific. ACIAR Monograph No. 9, 274p.

Dawson, R.F. 1986. Report on a Study of the Market for Giant Clam Products in Taiwan, Japan, Hong Kong and Singapore. FFA Report No. 86/37, South Pacific Forum Agency, Honiara, Solomon Islands.

Heslinga, G.A., and Fitt, W.K. 1987. The domestication of reef-dwelling clams. Bioscience, 37(5), 332–339.

Juinio, A., Menez, L.A.B., Villanoy, C.L., and Gomez, E.D. 1986. Status of Giant Clam Resources in the Philippines. Marine Science Institute, University of the Philippines, Diliman, Quezon City.

Lee, B. 1988. Giant clam farming — is there a bright future? Australian Fisheries, 47(7), 27–31.

Munro, J.L. 1985. Economic aspects of the development of mariculture systems for giant clams (Tridacnidae: Bivalvia) in the Australian region and the South Pacific. International Giant Clam Mariculture Project Discussion Paper No. 2, ICLARM South Pacific Office, Townsville.

Munro, J.L., and Heslinga, G.A. 1982. Prospects for the commerical cultivation of giant clams (Bivalvia: Tridacnidae). A paper presented at the 35th Annual Meeting of the Gulf and Caribbean Fisheries Institute, Nassau.

Tisdell, C.A. 1986. The economic and socio-economic potential of giant clam (tridacnid) culture: a review. Research Report or Occasional Paper No. 128, Department of Economics, University of Newcastle, NSW 2308.

Tisdell, C.A., and Menz, K. 1988. Socioeconomic considerations in giant clam mariculture. 246–249. In Copland, J.W., and Lucas, J.S. 1988. Giant clams in Asia and the Pacific. ACIAR Monograph No. 9, 274p.

Marketing Aspects

Preliminary Analysis of a Market Outlet Survey: Understanding Prawn Marketing in Papua New Guinea

D.R. Takendu[1]

Abstract

The internal distribution and marketing of prawns is not well understood or documented. An improved understanding in this area will not only contribute to appreciation of the fisheries economic linkages between the various sectors but also contribute to the development of consumption-oriented policy initiatives. Are prawns a luxury food? What is the demand for prawns in PNG? Do the fishing companies sell prawns on the domestic market? If so, where and how much? What importance does price have in dictating the pattern of consumption of prawns in the country? Is domestic prawn trading new and a growing activity? What is the role of imported prawns in domestic consumption? These are among some of the important questions which ought to be answered, perhaps not in this paper, but through subsequent studies.

Background

PRAWN fishing in Papua New Guinea has been widely documented. In 1987, some five companies operated in the industry. Total landing by all companies was 1067.9 t. Dominant species is Banana, accounting for 51.27% of the total production in that year. Next was Endeavour making up 16.61% (Table 1).

Table 1. Prawn catch in PNG, 1987.

	Species	Quantity (kg)	Percentage
1.	Banana	547402	51.27
2.	Black Tiger		
	Head on	91184	8.54
	Head off	34871	3.27
3.	Tiger		
	Head on	1862	0.17
	Head off	547	0.05
4.	Endeavour	177340	16.61
5.	Other	136588	12.79
6.	Mix	77788	7.29
	Total	1067582	99.99

Source: DFMR, Kanudi.

[1] First Assistant Secretary, Department of Fisheries and Marine Resources, Port Moresby, Papua New Guinea.

Production and marketing are basically done by the same entity(ies) although a number of trading companies have come into being. Where a company had no fishing effort of its own, greater reliance is made on the fishing companies for source of supply.

Survey Method

The survey covered four of the main companies which make up the industry. Questionnaires were sent to these companies in mid 1988. Only activities relating to the fiscal year 1987 were requested to be covered, thus, observations made in this paper relate to that time period.

Three questionnaires were completed and returned. This study was intended to be Part One of a two-part study on domestic prawn marketing. The second part was intended to cover selected clients of these fishing companies.

That is, after establishing who were the major clients of the fishing companies, those clients would then be approached to determine how prawns are further traded by them.

Exports

A major proportion of the catch is exported by all companies. Total production by each company is shown in Table 2, together with the respective exports. Exports as a percentage of all production for the companies averaged over 80%.

Table 2. Production and export in 1987 by company.

Company	Production (metric tonnes)	Exports (metric tonnes)
NGMP	523.8	450.64
PSEF	296.0	238.25
GPF	330.0	258.56
Total	1149.8	974.45

Source: Various fishing companies; may include carry-over of stock from previous year.

Of the total production of 1149.8 t, 84.75% was exported.

Imports

Between 1981 and 1986 fresh and frozen prawns imported amounted to 48.5 t for a value of K374 056. Prawns in brine totalled 11.9 t valued at K65 752.

Domestic Sales

Total domestic sales by the companies were approximately 85.1 t, just over 7.4% of all production. The three companies considered 109 clients as regular buyers. A distribution of the clients by industrial sectors is given in Table 3.

Table 3. Number of clients by industrial sectors (includes nonregular clients).

Sector	Number	%
Wholesalers/retailers	28	24.6
Hotels	16	14.0
Restaurants	31	27.2
Institutional barracks/mess	10	8.8
Other (nonregular clients)	29	25.4

Frequency of Sales

An attempt was made to see how often clients purchased prawns and the average sizes of orders. Below is a breakdown of sizes of orders by time interval:

Intervals	*Quantity (kg)*
Daily	175
Weekly	997
Biweekly	1982
Monthly	3959
Other	(Depended on availability of stock)

Geographical Distribution of Sales

Two aspects were considered. The first was the number of clients by location and the second, the quantity of sales to clients. Eighty-nine clients were based in Port Moresby while 39 were based outside (Table 4).

Table 4. Number of clients by location

Location	Number of clients
Port Moresby	89
Lae	13
Rabaul	8
Arawa	2
Kieta	2
Madang	2
Wewak	6
Goroka	1
Kerema	1
Other	4

Most of the clients are located in Port Moresby. Of the clients in other centres, the majority were from Lae, Rabaul and Wewak.

Among the clients in Port Moresby, one fish retail shop, hotels and restaurants were the main buyers of prawns. Prawn buyers who purchased over 1 t of prawns are presented in Table 5. Total quantity, value and the average price of prawns is also given.

Table 5. Major prawn buyers in Port Moresby, 1987.

Name of client	Quantity (kg)	Value (kina)	Avg price/kg
Yule Aperana	31128.5	146304.00	4.70
Travelodge	3880	31324.40	8.07
Islander Hotel	2092	9832.00	4.70
Papua Yacht Club	1808	9565.80	5.29
Kwantung Village Restaurant	1800	9398.80	5.22
Burns Philp Ltd	2456	18656.20	7.60
Galley Restaurant	2036	22988.90	11.28
Shanghai Garden Restaurant	2198	14527.00	6.61
Green Jade Restaurant	1214	5804.00	4.78
Total	48612.5	268401.10	5.52

Average prices for prawns paid by clients ranged from K4.70/kg to K11.28/kg. These prices compare favourably with the gross average price calculated. Five of the nine major clients paid lower average prices than the gross average price of K5.52/kg. The rest of the clients paid between K6.61/kg and K11.28/kg.

The price paid by Yule Aperana, the major buyer of prawns on the domestic market, was K4.70, the lowest average price paid by the clients surveyed.

It appeared from the survey that clients procured prawns from specific suppliers, although evidence exists that, gradually, other suppliers are breaking in and selling to traditional clients of other suppliers. An example of this is depicted by examining client retention patterns for sales made in Port Moresby.

Sales Outside Port Moresby

Main clients outside Port Moresby are again wholesalers, retailers, hotels and restaurants. Total sales to other centres are approximately 16.2 t. Over 9.3 t was sold by NGMP, 4.7 t by Pacific Seafoods, and 94 kg by Gulf Papua Fishery. Again the pattern of supplier-client relationship observed is rather discrete. Apart from sales made to Burns Philp Ltd in Lae, and Travelodge in Rabaul, no two suppliers supplied the same client in that year.

The main centres to which prawns were sold in order of importance were Lae, Rabaul, Kieta and Wewak (Table 6).

Table 6. Total sales to other centres — 1987.

Centre	Quantity (kg)
Arawa	58
Bulolo	28
Wewak	1487
Goroka	628
Lae	7064
Rabaul	3038
Mt Hagen	624
Kieta	2838
Madang	128
Hoskins	144
Kavieng	12
Kiunga	48
Kerema	58

Conclusion

The data presented represent an initial attempt to investigate the domestic prawn market in Papua New Guinea. Much work remains to be done to eliminate gaps in the data, and provide a clear understanding of the market situation. This applies not just to the prawn market, but to fish marketing in general in Papua New Guinea.

Japanese Tuna Markets: A Case for Marketing and Distribution Research

S.C. Williams[1]

Abstract

The Coral Sea tuna fishery is a classic case of marketing myopia in the fisheries development process. There is a general tendency for fisheries managers to concentrate on production factors and exclude marketing and distribution from planning considerations. In this paper, some possible reasons for this behaviour are explored, and the need for market research input is highlighted using examples taken from the Japanese tuna markets.

Introduction

THE Coral Sea tuna fishery off North Queensland is a potentially lucrative source of export earnings. Large numbers of yellowfin (*Thunnus albacares*) and bigeye (*Thunnus obesus*) tunas occur in seasonal concentrations in surface waters near Cairns each year, and are readily accessible by Japanese and Queensland fishermen using a variety of gears (handline, pole and line, longline) set from modified prawning or purpose-built vessels (Williams 1986). Since 1981, the Queensland and Commonwealth governments have invested more than $1.5 million of public funds to develop this fishery.

These outlays have had three aims: first, to encourage local fishermen to participate in the lucrative *sashimi* tuna trade to Japan; second, to take pressure off prawn stocks by diverting excess effort into an adjacent fishery; and third, to take advantage of access agreements to Japanese seafood markets gained through government negotiations for Japanese vessels to enter the Australian Fishing Zone (AFZ).

Looking back over eight years of government effort, the results have been disappointing. The fishery remains in its infancy. The initial interest of Queensland fishermen in catching tuna has waned, and some strong anti-Japanese feeling has resulted. The fishery is seen as 'too difficult' and 'too risky' and fishermen are not inclined to invest. Shipments of tuna air-freighted as chilled product to auctions in Japan have not received consistently 'good' prices. Dramatic variations in auction price for apparently identical fish of seemingly high quality have convinced many fishermen that they are being unfairly discriminated against in the market for political/nationalistic reasons. Similar complaints have also been voiced by New Zealand and American tuna exporters to Japan (Nakaishi, pers. comm. 1987).

To an economist or marketer, these results immediately suggest that some type of market failure or market imperfection is operative, and that some market research needs to be done. However, in spite of these problems, the major part of government investment in the fishery continues to go towards 'proving' the resource, the emphasis on the means of production. Almost no funding for market research into Japanese tuna markets has

[1] Darling Downs Institute of Advanced Education, Post Office, Darling Heights, Toowoomba, Queensland, Australia.

been provided by Commonwealth or State governments since 1981. While this may seem surprising to most marketers, who would tend to start at the market end with buyers/consumers and work back to development of an export product to suit their needs (the 'marketing concept' approach — Kotler 1972), it is nothing new. One can suggest a number of possible explanations for such seemingly short-sighted behaviour, as follows:

Management by Numbers

For most fisheries, management objectives (where they are written down) focus very closely on factors of production. There are considerations of the likely effects of development on the abundance of the stocks, and thus the catch rates of the fishery concerned. There is a preoccupation with numbers (e.g. fishing units, total allowable catch, TACs) which tends to divert the attention of fisheries managers away from other important aspects of fisheries development, such as marketing and distribution, where the product of the fishery must be marketed in a way that maximises total revenue at each level of output (Van Meir 1965; Austin 1977; Young 1986).

Agriculture Department Syndrome

Another possible reason for the lack of attention to marketing was put forward by Phillips (1968), who noted that market research in agriculture traditionally has been preoccupied with storage and transport, which are in fact *production* problems. As most fisheries agencies in Australia are located within the various state and federal departments of agriculture ('Primary Industry'/'Industries'), this narrow view of the role of market research may explain the apparent lack of government interest.

Lack of Awareness

A third reason might be that the role of marketing in fisheries development has not been promoted in the fisheries management literature. On a close inspection, however, this is found not to be the case, as the necessity of conducting market research in the development of new fisheries has been identified by many authors (for example Van Meir 1965; Prochaska 1984; Waugh 1984; and Young 1986). It was identified specifically for skipjack tuna by Shand (1969), and for the Australian east coast tuna fishery by Bain (1985).

Although all of these authors *mentioned* the need for a consideration of marketing, however, only Van Meir (1965), MacSween (1983), and Young (1986) elaborated on its vital importance to management planning, particularly with respect to fisheries development.

Lack of Interest

While governments in Australia have become involved in seafood marketing and some limited market research on the domestic side in order to smooth short-term price fluctuations and thus uncertainty of income to the producer (Davidson and Stewardson 1974), there has been apparently little interest on the part of government on the export side. This is in contrast with other export commodities such as meat, wool, sugar and wheat. One reason suggested for this apparent anomaly is that it was only comparatively recently that fishermen became politically organised and gained recognition as bona fide primary producers (Spencer pers. comm. 1986).

Lack of Secondary Information

Most work done on tuna relates to the biology of the various species and methods of capture, to various aspects of tuna quality preservation, or to historical aspects of tuna fisheries management. For example, articles on the Japanese fishing industry have been published by Cassady (1967, marketing); Herrington (1971, management); Kester (1980, demand and consumption). Quality aspects of tuna meat have been studied by Warashina and Hisada (1970), Bito (1976), Konagaya and Konagaya (1978), Takahisa (1983), Suzuki (1983) and Suyama (1984). Market descriptions have been published by Akiya (1981) and Tayama (1982), but the empirical content of seafood market studies available in Japan appears to be low.

Much of the available literature is confusing. For example, tuna characteristics assumed to determine auction price are cited as: bleeding (Rowly 1983), texture (Kirimura 1984), mishandling (Franklin and Kitson 1982), oil content (Gibson 1981; Williams 1982; Kirimura 1984); freshness (Payne 1981; McEachern 1984; Wilson and Cade 1984); weight (Gibson 1984); meat colour (Gibson 1984); origin (Stevens 1982). Empirical work done by Wilson (1982) showed *no* relation between freshness, colour and auction price.

If we look just at meat colour, bigeye has been described by Shoji (1972) as 'pink-coloured,' Tayama (1982) describes it as 'dark,' Suyama (1984) as 'dark pink' and Awaya (1985) as 'brillant red.' Yellowfin has been described by Harman and MacMillen (1973) as 'dark,' Shoji (1972) describes it as 'brilliant pink,' Tayama (1982) as 'light pink.'

Interesting, but not very useful when one is attempting to understand consumer preferences for meat colour.

Market Information Problem

Some limited but detailed market research work done independently by Williams (1986) and Williams and Longworth (1988) on tuna auction markets in Japan highlights the poor quality of information in the hands of Queensland tuna fishermen, processors and exporters.

This can be attributed directly to the poor quality of information in the hands of the *sources* of information the fishermen use, and in turn linked *directly* to the lack of market research being done (by government or industry). This is clearly a market imperfection which must be attended to.

Impact of Change

The difficulties of market research in Japan, such as language, customs and high cost, have been described by Herrington (1971) and Watt (1980). Given the researcher is able to overcome all of these problems, the next issue to cope with is that of rapid change, which renders his hard-won research information rapidly obsolete. The Japanese tuna market is characterised by rapid change along many dimensions. In other words, the primary conditions which determine the quantity of commodity produced and exchanged, and the price at which it sells, are changing rapidly.

Some of these changes are:

1) Changes in consumer tastes, preferences, and consumption patterns (Taya 1985, 1986, 1988; Japan Fishery Agency 1988; Marine Products Yearbook 1988).
2) Changes in the prices of competing products (Marine Products Yearbook 1988).
3) Changes in the competitive situation with regard to suppliers to the Japanese market (Williams 1986).
4) Changes in consumer income (Taya 1985; Marine Products Yearkbook 1988).
5) Changes in the political situation with respect to the Japanese tuna fishing industry (Marine Products Yearbook 1988).
6) Changes in technology (Marine Products Yearbook 1988).
7) Changes in distribution (Taya 1988).
8) Changes in Japanese tuna fishing fleets (Marine Products Yearbook 1988).
9) Changes in product form (Tayama 1981; Taya 1985).

The importance of market research to fisheries development can be illustrated by taking just one of these areas (e.g. consumption) and examining it in some detail.

Consumption Patterns

According to Taya (1988) there have been major changes in the patterns of consumption of tuna in Japan over the past 5 years and these changes are continuing and accelerating. First, there has been a great increase in the number of meals eaten away from home. The recent trend for working wives (with school-age children) to reenter the workforce and supplement family income has meant that most shopping is now done after work and more meals are consumed at restaurants in shopping centre areas. Consequently, a greater proportion of seafood is being consumed in restaurants, which have a very different spectrum of demand variables to the traditional neighbourhood fish shop (*sakana-ya*). Fish for restaurants is bought on the basis of (a) stable supply, (b) stable price, (c) consistent quality, (d) standardisation and (e) reliability of delivery (Japan Self-Service Organization 1984). Unfortunately for the tuna industry (especially chilled tuna), seafoods such as salmon, prawns and squid tend to 'fit' these requirements more easily than tuna, and have the added advantage of versatility in cooking and presentation use. The dramatic rise in tuna consumption promised by the restaurant boom has therefore not occurred to the extent expected (Taya, pers. comm. 1986).

The same factors which led to a rise in 'eating out' have also led to changes in the way seafoods are sold in supermarkets and department stores (where most working wives tend to shop, because when time is short it is more convenient to do all the shopping at one place). There is an increasing trend to the sale of seafoods in a ready-to-eat or quickly prepared form. According to Taya (pers. comm. 1988), sales of blocks of *sashimi* tuna meat on polystyrene trays for cutting and preparation at home are giving way to attractive ready-to-serve *sashimi* packs (of which tuna is but one component). No further preparation for a meal is required, and the food can be served immediately.

As a consequence, sales by traditional seafood shops are declining and sales by supermarkets and department stores are increasing (again there has

been a dramatic change in the demand variables applying to the wholesale markets for tuna). Sales by supermarkets topped sales by traditional outlets in 1984 (Marine Products Yearbook 1988). The swing to 'convenience seafoods' has also resulted in greater preference for fish which have a variety of uses (e.g. main meal/school lunches/treats/snacks). Salmon is far more desirable than tuna in this regard (more versatile — Taya, pers. comm. 1988).

From a fundamental marketing point of view, the changes in consumers' incomes and lifestyles are generating a whole new set of needs and wants in which the traditional product '*sashimi* tuna' has been repositioned with respect to other seafoods and meats. In this new environment, Taya (1988) expects that per capita consumption of *sashimi* tuna to decline in favour of other competing foods (e.g. salmon, beef). The current difficulties in shifting excess stocks of low-grade frozen tuna (even at low prices) are cited as evidence of this (Marine Products Yearbook 1988).

Changes in Consumption Patterns

Traditionally, consumption of tunas has been greatest in the far south and east, and least in the west (see Fig. 1). This has been linked to traditional fisheries and also to the different *nature* of the fish populations of the east vs the west coast (Williams 1988). On the west coast, mackerels and white-flesh species are preferred as *sashimi* over tuna. As well as these general preferences there are region-by-region differences in preferences for tuna species, forms, grades, sizes and origins (Williams 1986).

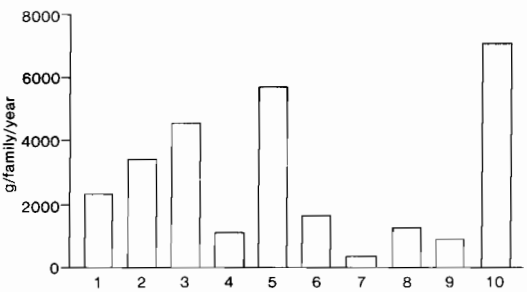


Fig. 1. Tuna consumption by region. 1 Hokkaido, 2 Tohoku, 3 Kanto, 4 Hokuriku, 5 Tokai, 6 Kinki, 7 Chugoku, 8 Shikoku, 9 Kyushu, 10 Okinawa (source: Japan Fishing Agency 1988).

In recent years, however, it has been found that these 'traditional' regional preferences have been changing (Fig. 2). According to Taya (1986), Okinawa has the highest consumption of tunas (7 kg annually per family), Fukuoka consumes only 0.17 of the national average, while Kanto (Tokyo area) consumes 1.8. If this is so, then there are implications for marketing and distribution, especially in relation to choice of auction market. For example, Nakaishi (1988 pers. comm.) reported that there was an increasing trend towards the consumption of bigeye tuna in the Osaka area, where the sales of yellowfin tuna usually far exceed those of bigeye. If the trend is confirmed, then there may be an opportunity for second-grade (less oily) bigeye to be diverted from the Tokyo market (where fat content obtains a premium) to Osaka, where there has been a 'traditional' preference for 'less oily' tuna species (Williams 1986).

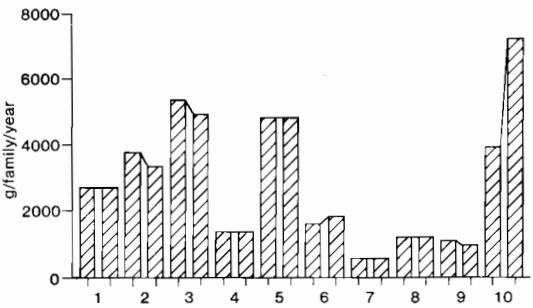


Fig. 2. Tuna consumption by area, 1976–86: 1 Hokkaido, 2 Tohoku, 3 Kanto, 4 Hokuriku, 5 Tokai, 6 Kinki, 7 Chugoku, 8 Shikoku, 9 Kyushu, 10 Okinawa (source: Taya 1988).

Changes in Consumption with Prices

According to the Marine Products Yearbook (1988), there has been a dramatic change in price relativities between seafoods and other meats (Table 1), with the effect that many seafoods are now priced much higher than competing sources of animal protein. According to empirical work by Taya (1988), a 10% fall in the beef price will result in a 23.8% fall in tuna consumption. Both are

Table 1. Price relativities, fish vs meats 1965–70 and 1980–85.

1965/70		1980/85	
	Tuna		Tuna
Pork =	Yellowtail	Pork <	Yellowtail
	Prawns		Prawns
	Crabs		Crabs
	Large mackerel	Pork =	Squid
	Horse mackerel		
Pork >	Squid		Horse mackerel
	Pike		Large mackerel
	Sardine	Pork <	Pike >Chicken
			Pike
			Sardine

Source: Marine Products Yearbook (1988)

'festivity' items, and even though they are not directly comparable (raw beef is not really a '*sashimi*' substitute), they are considered comparable as choices for a 'high class' or 'festive' meal item.

Changes in Product Form

Tayama (1982) and Suzuki (1983) have described the changes in product form for tuna marketed in Japan coinciding with the rise of supermarkets and department stores as primary purchase points for seafoods. The trend has been to push tuna processing to retail-size packs to lower points in the distribution chain, so that most of the frozen tuna entering Japan from Taiwan and Korea is in the form of chunks and steaks (Tayama 1981).

For chilled tuna, the bulk is still processed by the *nakaoroshi* at their middlemen's stalls in the central wholesale markets, but this product is mainly destined for fish shops and the 'higher class' of restaurant trade. Recent developments in wrapping materials for chilled tuna loins and steaks have led to improvements in colour preservation, but this has not halted the trend to frozen tuna distribution through supermarkets and department stores (Taya, pers. comm. 1988). As well as the advantages of stable price and supply, frozen tuna offers the retailer the ability to present tuna blocks and steaks with neatly cut edges, which are more visually appealing than sliced, chilled tuna steaks (Williams 1986). In other words, the product 'chilled tuna' is missing out on possible growth of tuna consumption through the supermarket and department store trade.

Changes in Consumption Patterns

Age/Sex Differences It is interesting to compare the household consumption of beef and tuna against the variables of age and sex. Such comparisons reveal the uses of tuna and beef as products. Taya (1985), using consumption data for 30 000 families (food eaten at home), has shown that there are marked differences in consumption patterns of tuna and beef between men and women of different ages. For example, middle-age men consume much more tuna than women (Fig. 3 and 4). This might be explained by the fact that tuna is considered a 'treat' for the head of the family to be enjoyed with *sake*. Women tend to eat more beef because it is considered good food for children, and the wife eats with the children long before the husband arrives

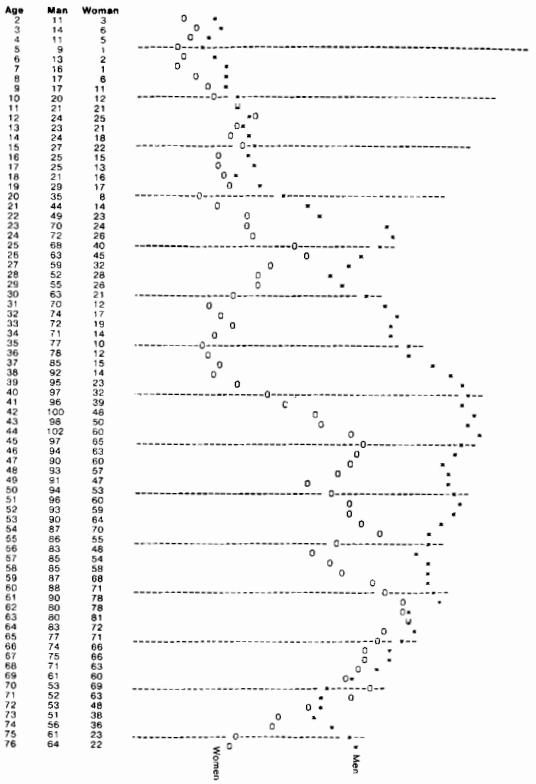


Fig. 3. Tuna consumption (grams per month) by age and sex (35 000 families, 1984 data) (source: Taya 1986).

home. As women get older (and the men retire), they tend to share more meals together and the wife then eats more tuna (Taya, pers. comm. 1988). Such information is vital for promotional programs designed to increase tuna consumption.

Factors Influencing Consumption According to recent work by Taya (1988), the home consumption of tuna (quantity demanded) is influenced (in order of magnitude) by: (1) tuna (retail) price, (2) beef retail price, (3) yellowtail (*Seriola* sp.) price, (4) salted salmon (mix of species) price, and (5) bonito (skipjack — *Katsuwonus pelamis*) price. Taya's consumption function is cited as: log Q = 1.229–1.107 log (tuna price) + .826 log (beef price) + .532 log (yellowtail price) + .274 log (salted salmon price) + .206 log (bonito price). Although salted salmon is not given much weight in this equation, its importance may be much greater than Taya's findings suggest. Taya (1988, pers. comm.) is convinced that the fortunes of the tuna market are tied to the market for salmon (especially salted

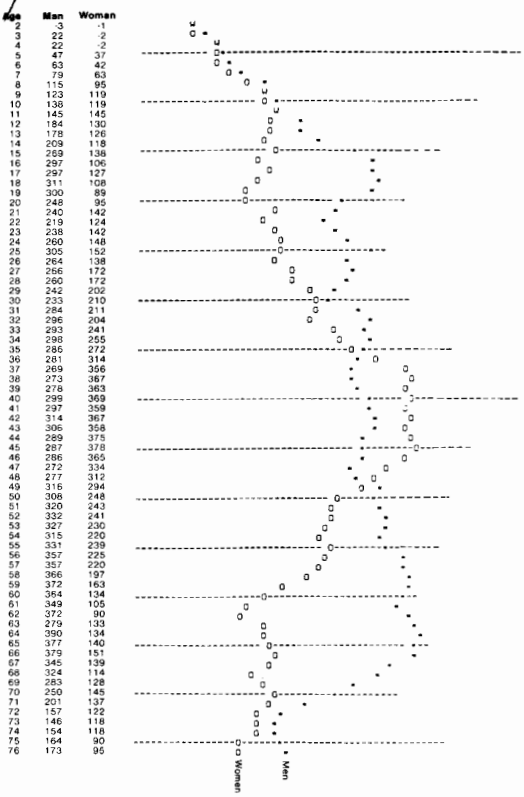


Fig. 4. Beef consumption (grams per month) by age and sex (35 000 families, 1984 data) (source: Taya 1986).

salmon), which he expects to remain very strong in Japan, especially at year end, where it is being increasingly used as a celebratory gift (Fig. 5 and 6). The average consumption of salmon in 1985 was estimated at around 5 kg/family (Japan Fishery Agency 1988), and this is expected to increase given the product's very high 'useability' factor. It is a popular food with all generations, it is very versatile and easy to use in a wide range of cooking and

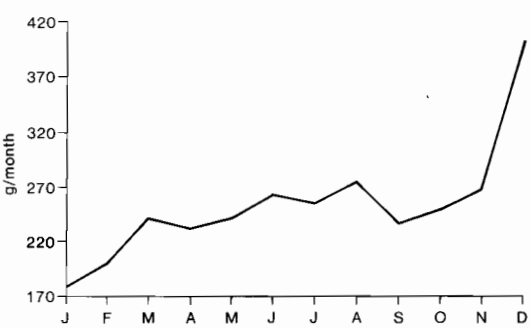


Fig. 5. Monthly consumption of tuna, grams per family (source: Japan Fishery Agency 1988).

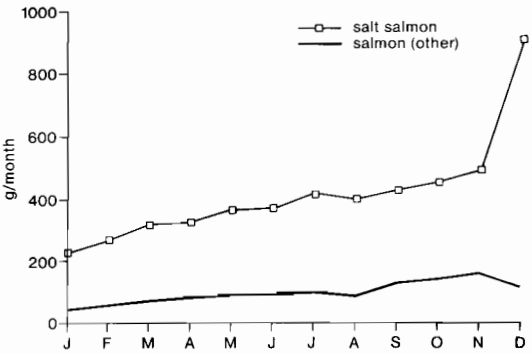


Fig. 6. Monthly consumption of salted salmon, grams per family (source: Japan Fishery Agency 1988).

presentation styles, it is popular with rice in school lunches and it is available in a multitude of species, forms and grades.

Implications for Market Research

These brief examples of changes presently occurring in the Japanese tuna market highlight the needs for continuing and detailed market research, the input of accurate market research information to the fisheries management process, and the need for flexibility in development and marketing policies. The value of gathering primary data in Japan (or any market) is that it enables the decision-maker to push through the web of incorrect, out-of-date and misleading market information to get at the facts. The problems associated with secondary data and market intelligence from the Japanese market have been described previously. In addition, one must be aware of the problem of *disinformation*, an area familiar to most new fishermen entering the industry (Williams 1986).

The kinds of research that can be done in overseas seafood markets range from detailed studies of buyer behaviour at various levels of the distribution chain to assessments of market structure, conduct and performance. Such 'classical' market studies reveal much information of value to exporters. Simple marketing research questions provide valuable insights into ways to position the product in the market to maximise returns. For example: Who are our competitors? How do they operate (competitive behaviour)? Where do they operate? What are their short-term and long-term strategies?

Conclusion

Given the foregoing, it can be seen that the benefits of good primary market research information (e.g. timely, accurate, relevant) to new

fisheries development cannot be questioned. In the case of the Japanese market, buyer requirements (specifications) for product dictate vessel type, fishing method used, method of handling and processing, grading systems, size, conformation, fishing season, packing and presentation, and transport logistics (Williams 1986, 1988). The point is that such market research is still not being done. The case of the Coral Sea tuna fishery is not an isolated one. Fisheries managers must broaden their view away from the factors of production to include marketing and distribution. The Coral Sea tuna fishery is a classic marketing case of too much emphasis on the product and production (Sales Concept, Kotler 1972) and not enough on the consumer (buyer) and marketing (Marketing Concept).

References

Akiya, S. 1981. Central Wholesale Markets — Merits and Demerits of Auctions. Japan Economic News. Tokyo. (In Japanese).

Austin, C.B. 1977. Incorporating economic considerations into practical fisheries policies. In Anderson, L.G. (ed.) (1977) Economic Impacts of Extended Fisheries Jurisdiction. Proceedings of a Symposium sponsored by the University of Delaware Sea Grant College Program and the National Marine Fisheries Service. Ann Arbor Science Publishers. Ann Arbor, Michigan.

Awaya, M. 1985. Encyclopedia of Fish and Fish Dishes. Tokyo. (In Japanese).

Bain, R. 1985. Fisheries administration in the AFZ. Infofish Marketing Digest, No 4/85, 17–22.

Bito, M. 1976. Studies on the retention of meat colour of frozen tuna. Bulletin of the Tokai Regional Research Laboratory No 84, February, 51–113. (In Japanese).

Cassady, R. Jr. 1967. Auctions and Auctioneering. University of California Press.

Davidson, F.G., and Stewardson, B.R. 1974. Economics of Australian Industry. Longmans Australia Pty Ltd, Victoria.

Franklin, P., and Kitson, G. 1982. *Sashimi* — The Japanese market. Infofish Marketing Digest, 5, 16–22.

Gibson, D.J.M. 1981. A Handbook on Processing Southern Bluefin Tuna for the Fresh Chilled *Sashimi* Market in Japan. New Zealand Ministry of Agriculture and Fisheries. Wellington.

1984. Southern Bluefin Tuna for the *Sashimi* Market. New Zealand Ministry of Agriculture and Fisheries. Wellington.

Harman, G.W., and MacMillen, M.J.J. 1973. The Market for Tuna. Tropical Products Institute. London.

Herrington, W.C. 1971. Operation of the Japanese fishery management system. Occasionl Paper No 11. Occasional Paper Series, Law of the Sea Institute, University of Rhode Island. New York.

Japan Fishery Agency. 1988. Structure and characteristics of marine products consumption. Analysis of consumption by age and sexes. Marine Economic Research. No 45. March 1988.

Japan Self-Service Organization. 1984. Fresh Fish Business Manual. Yanamoto Printing Co. Tokyo. (In Japanese).

Kester, A.Y. 1980. Demand for fish in Japan and the westernization of the Japanese diet: Implications for Japan's demand for feed. Unpublished discussion paper. Department of Agriculture. University of Queensland, St Lucia.

Kirimura, K. 1984. Handling and Processing Bluefin Tuna. Industry information leaflet. Nichiro Gyogyo Kaisha Ltd. Halifax, Nova Scotia.

Konagaya, S., and Konagaya, T. 1978. Denaturation at moderate temperatures of myofibrillar protein of red-meat fish: A possible cause of *yake-niku*. Bulletin of the Tokai Regional Fisheries Research Laboratory. No 96. (December) (In Japanese).

Kotler, P. 1972. Marketing Management — Analysis, Planning and Control. Prentice-Hall Inc. New Jersey.

MacSween, I. 1983. The interaction between fisheries management and the marketing of fish. In Food and Agriculture Organization of the United Nations. Expert Consultation on the Regulation of Fishing Effort (Fishing Mortality). Rome 17–26 January 1983. Food and Agriculture Organization of the United Nations. Rome.

Marine Products Yearbook. 1988. Suisansha Tokyo.

McEachern, D.B. 1984. The Japanese Tuna Market. Unpublished Administrative Report. Department of Fisheries and Oceans. Ottawa.

Payne, D.A. 1981. The Japanese Market for Chilled and Frozen Southern Bluefin Tuna. Winston Churchill Fellowship Marketing Study. New Zealand Fishing Industry Board. Wellington.

Penn, E.S., and Crews, W.J. 1979. Value added, margins and consumer expenditures for edible fishery products in the United States 1976–1978. Marine Fisheries Reviews, 41(12), 1–9.

Phillips, J. 1968. A revised approach to marketing. Review of Marketing and Agriculture Economics, 36(1), 28–36.

Prochaska, F.J. 1984. Principal types of uncertainty in seafood processing and marketing. Marine Resources Economics, 1(1), 51–66.

Rowly, M. 1983. Guide to handling chilled fresh tuna for export to Japan. Australian Fisheries, 42(3), 20–22.

Shand, Y.C. 1969. The skipjack tuna industry in Hawaii: Some economic aspects. Economic Research Centre. University of Hawaii.

Stevens, R.A. 1982. An insight into the Japanese market. South Australian Fishing Industry Committee (SAFIC), 6(3), 10–15.

Suyama, M. 1984. Characteristics of tuna meat. In The 7th Tokyo Fisheries College Open Lectures, Tuna — From Production to Consumption. The 7th Tokyo Fisheries College Open Lectures. Tokyo. Fisheries College, Tokyo. (In Japanese).

Suzuki, T. 1983. Taste of Fish. Science of Seafood. Kyoritsu Publishing Company. Tokyo. (In Japanese).

Takahisa, H. 1983. How to Distinguish Fish at the Market. (2nd Edition) *Nikkan Shokuryo Shimbun-Sha*. Tokyo. (In Japanese).

Taya, K. 1985. Tuna demand and price. In Tuna Fisheries Research Conference Report. Miho Kenshukan, Tokai University 2438. Miho. Shizuoka. Deep-Sea Laboratory. Japan Fishery Agency, July 1987.

1986. Supply and demand of tuna and pricing — Report. Tokaiku Marine Laboratory. May.

1988. In Economic Structures of the Off-Shore Fishing Industry. Dai Nihon Suisankai, March.

Tayama, J. 1981. The Story of Tuna. From the Fishing Grounds to the Table. Kyoritsu Publishing Company. Tokyo. (In Japanese).

1982. The Story of Tuna (continued). Taste and Trade. Kyoritsu Publishing Company. Tokyo. (In Japanese).

Van Meir, L.W. 1967. A study of policy consideration in managing the Georges Bank Haddock fishery. In Bell, E.W. and Hazleton, J.E. Recent Developments in Research in Fishery Economics. Papers presented at a Conference on Fisheries Economics. New England Economic Research Foundation. Oceana Publications. New York.

Warashina, I., and Hisada, K. 1970. Spawning activity and discoloration of meat and loss of weight in the southern bluefin tuna. Bulletin of the Far Seas Fisheries Research Laboratory, No 3, 147–166. (In Japanese).

Watt, A. 1980. The value of market research. In Norbury, P. and Bownas, G. (ed.) Business in Japan: A Guide to Japanese Business Practice and Procedure. Macmillan Press Ltd., London.

Waugh, G. 1984. Fisheries Management: Theoretical Developments and Contemporary Applications. Westview Press. Colorado.

Williams, G. 1982. Notes on the Economics of the Coral Sea Tuna Fishery. Unpublished Administrative Report. Fisheries Division. Commonwealth Department of Primary Industry. Canberra.

Williams, S.C. 1986. Marketing Tuna in Japan. Queensland Fishing Industry Training Committee. Brisbane.

1988. Marketing Chilled Fish in Japan. Queensland Department of Primary Industries, Brisbane.

Williams, S.C., and Longworth, J.W. 1988. Factors influencing tuna prices in Japan and implications for the development of the Coral Sea tuna fishery. Proc 32nd Annual Conference of the Australian Agricultural Economics Society. LaTrobe University, February 8–11.

Wilson, N.D.C. 1982. Some aspects of the handling and processing of tuna in New Zealand's south island west coast fishery: A preliminary investigation. Massey University Food Technology Research Centre. Report No 5. Massey University. Christchurch, New Zealand.

Wilson, M.A., and Cade, R. 1984. Air-freighting fresh chilled tuna to the Japanese *sashimi* market. Infofish Marketing Digest, No 4/84, 45–47.

Young, J.A. 1986. Fish marketing: The importance of interdependence. Fisheries Economics Newsletter, No 21, May, iii–viii.

Modelling Tuna Markets: Some Preliminary Observations

A.D. Owen[1]

Abstract

International commodity markets are complex structures, usually featuring, directly or indirectly, a large number of organisations involved in production and consumption. They operate in an environment moulded not only by economic but also technological, political, legal, and cultural influences, and consequently economic models cannot be expected to duplicate this complexity and detail. Nevertheless, by judicious simplifications and abstractions it is possible to represent the essential elements of the underlying market framework in terms of a number of mathematical functions. The purpose of this paper is to provide a framework for the study of tuna markets. We begin by making some general observations concerning the specification of economic models of commodity markets, before giving specific consideration to the tuna market. Even at a relatively aggregate level, it is apparent that substantial data and research resources would be required before the model could be estimated and used for policy purposes. Nevertheless, we hope it provides an introduction to a topic that is capable of yielding valuable market information. In particular, pinpointing key socioeconomic determinants of demand allows more effective targeting of advertising and promotional campaigns, while price and income elasticities clearly play a major role in policy analysis.

Introduction

ECONOMIC theory dictates that all commodities are, in effect, substitutes since they all compete for the consumer's limited income. However, there are a number of items which are essential to ensuring a minimum level of existence. Basically, these are food, shelter and clothing. After these basic needs are satisfied, then consumers possess a much greater degree of discretion regarding the means of disposing of their remaining purchasing power. Generally speaking, consumer goods which are basic living requirements tend to have low income and price demand elasticities, whereas goods competing for the consumer's discretionary income tend to have higher elasticities. In the industrialised nations of the world there are very few items which fall into the former category, and consequently the demand for most consumer goods is highly responsive to changes in real income and relative prices.

Since real income and relative prices are frequently the major determinants of demand, the magnitude of their corresponding elasticities is obviously of prime importance to producers of consumer goods. The purpose of this paper is to provide a framework for the study of tuna markets and their associated elasticities. We begin by making some general observations concerning the specification of economic models of commodity markets, before giving specific consideration to the tuna market. Even at a relatively aggregate level, it is apparent that substantial data and research resources would be required before such a model could be estimated and used for policy purposes. Nevertheless, we hope it provides an introduction to a topic that is capable of yielding valuable market information. In particular, pinpointing key

[1] School of Economics, University of New South Wales, PO Box 1, Kensington, NSW 2033, Australia.

socioeconomic determinants of demand allows more effective targeting of advertising and promotional campaigns, while price and income elasticities clearly play a major role in policy analysis.

Modelling Commodity Markets

International commodity markets are complex structures, usually featuring, directly or indirectly, a large number of organisations involved in production and consumption. They operate in an environment moulded not only by economic but also technological, political, legal and cultural influences, and consequently economic models cannot be expected to duplicate this complexity and detail. Nevertheless, by judicious simplifications and abstractions it is possible to represent the essential elements of the underlying market framework in terms of a number of mathematical functions.

A hierarchy of commodity market models can be visualised going from the very simplest, most highly aggregated system to increasingly complex disaggregated models. These range from modelling world supply and demand by just two equations, down to the low levels of aggregation associated with studies using family expenditure survey data and generally involving a substantial number of equations. In general, the degree of disaggregation is dependent on the requirements of the user and on the financial and data resources available for model construction. Disaggregation is not a virtue in its own right, but highly aggregated models may obscure fundamental market relationships as well as introducing statistical problems at the estimation stage. However, disaggregation may involve substantial data procurement problems as well as additional complexity with model specification and estimation.

The diverse and complex processes operating in many commodity markets can only be represented by highly disaggregated models. Whereas the simplest models focus only on the determination of a price and limited output and consumption quantities, more complex models can introduce a number of prices, different grades of the commodity, interrelationships between inventory accumulation at various stages of the production-consumption pipeline, speculative phenomena, production cost functions, and a variety of production control and stabilisation mechanisms. While these recognise much more of the true complexity of the real world, they may also be more difficult to use for prediction or simulation. This stems largely from the greater data and skilled staffing requirements, the need for a large number of exogenous variables which may themselves be difficult to predict, and possibly instability of some of the processes being described.

Specification of a Simple Model

A simple economic model for a hypothetical commodity will now be discussed in general terms. The model will consist of just three behavioural (or structural) equations and an identity to 'close' the model. These four equations will explain commodity supply, demand, price determination and inventory accumulation.

The supply function is expressed as

$$Q_s = f(P_c^e/C, T_1, S) \qquad (1)$$

This equation states that the quantity supplied to the market (which could be the total world market, or just a single consumer nation or block of nations) is determined by responses to the expected price of the commodity (P_c^e) relative to factor costs (C), technological or ecological trends (T_1) in harvesting the resource base, and seasonal variables (S). Some form of expectations hypothesis must be specified to render P_c^e observable.

The demand function is expressed as

$$Q_D/POP = f(P_c/P_s, Y/POP, T_2) \qquad (2)$$

Demand (or consumption) is defined in per capita form, i.e. per head of the population whose demand is being measured. It is determined by the relative price of the commodity (P_c/P_s), where P_s is the price of substitutes, per capita income (Y/POP), and consumer tastes (T_2). It is possible that seasonal variables will also be included in this equation.

The price function is expressed as

$$P_c = f(I/Q_D) \qquad (3)$$

where I is the level of inventories at the beginning of the time period under consideration. Thus I/Q_D represents the relative (to demand) level of inventories. One would expect this variable to be inversely related to the price of the commodity.

In a perfectly competitive market (i.e. a large number of buyers and sellers acting independently with perfect knowledge, and trading in a homogeneous product) elementary economic theory dictates that prices would be determined by the unhindered interaction of supply and demand in order to ensure market clearance. However, in practice, market imperfections, political interference, and oligopolistic practices combine to frustrate this process and as a result most

commodity markets suffer from multiple pricing regimes. The most obvious source of price variation arises from variations in product quality, but separate 'producer' and 'market' prices are frequently quoted. With a relatively simple model, however, we require a single representative price to act as a surrogate variable for all such prices. Frequently it is possible to achieve this end, although it is not uncommon to see a number of different prices in even small models of commodity markets.

Finally, an identity is used to close the model:

$$I = I_{-1} + Q_S - Q_D.$$

This equation defines the level of inventories as arising from the sum of the previous period's level of inventories plus (minus) the excess (shortfall) of supply over demand. However, it should be noted that an equation specifically designed to model the determinants of inventory accumulation can be derived simply by rewriting the price equation with inventories as the dependent variable.

For most nonperishable commodities, inventories can be held for lengthy periods of time (at a cost!) without major problems associated with quality decline. The cost involves not only the cost of physically storing the commodity, but also the opportunity cost incurred by investing in and holding that commodity (for some commodities this could be the cost of speculation). For perishable commodities, however, long-term storage is frequently undesirable or only available at high cost. Thus while (for example) tuna fish can be chilled or frozen if not required immediately, this is a relatively short-term solution which is only available at substantial cost. Frequently it is undertaken to simply smooth-out seasonal fluctuations in demand and consequently is essentially short-term in nature. Long-term, relatively cheap, storage is possible by canning the product, although this changes the nature of the good. As a consequence, with many perishable commodities, prices tend to respond rapidly to imbalances in supply and demand, with the possibility of instability always present.

Definitions

Tuna is not a homogeneous product. Different species provide different qualities of meat, at correspondingly different prices, while a variety of marketing styles (fresh, frozen, canned in oil, canned in brine) exist in the retail sector. Given adequate data, it would be possible to disaggregate a model of the tuna market to consider such individual products. However, in this paper we will assume that the generic term 'tuna' covers all possible qualities and marketing styles in a single category.

The tuna market for a nation, or group of nations, is comprised of three general sectors: domestic landings, wholesale (including imports), and retail. A model that is complete in the economic sense would include a supply, demand, price, and (possibly) inventory equation for each of these sectors. Data for tuna markets are usually limited to supplies entering the market over a period of time (i.e. imports, domestic landings, beginning of period cold storage holdings), the market prices (ex-vessel, wholesale, and retail), apparent consumption, and end of period cold storage holdings. Data are generally not available to quantify what happens in between e.g. quantities moving through wholesale channels or held in storage at retail or final consumer levels are not recorded.

The *supply* of tuna to a market in any time period (say 1 month) will be the sum of three components: domestic landings, beginning of period stocks, and imports. While domestic landings will clearly be measured in terms of weight of fresh tuna, the other two components will involve tuna stored in either chilled, frozen or canned form. Thus total supply must be expressed in terms of weight of 'fresh fish equivalence' in order to standardise units of measurement. According to this definition, supply is measured by the quantity of tuna at the wholesale stage of the production-consumption pipeline.

The *demand* for a commodity is generally measured as the amount of that commodity 'disappearing' from the marketplace. This is sometimes referred to as 'apparent consumption,' and is comprised of actual consumption plus the change in consumer inventory. Separate data on these two variables are not generally available. It is apparent from the above definitions that inventories can be held at various stages of the production-consumption pipeline, and at a number of such points measuring such inventories is a very difficult, if not impossible, task. However, it would appear that inventories of tuna are small relative to total supply and that supply/demand imbalances are rapidly reflected through the price mechanism rather than through any long-term inventory relationship.

Factors Influencing Tuna Supply

Supply analysis is a neglected area with economic modelling of fish markets, largely because of

difficulties in specifying the production process of a renewable resource. There are gaps in our knowledge of the biological relationships underlying the process, and consequently many studies assume supply to be completely determined outside of the model. A nation's domestic landings of tuna are clearly dependent upon a combination of 'fishing effort,' national and international harvesting practice, and the relative abundance of tuna. The latter is largely biological in nature, and is consequently exogenous to any model. Clearly these three variables are not uncorrelated and, over a period of time, their relative importance may vary greatly. However, measuring these variables is not an easy task.

Data exist on the tuna fishing capacity of vessels from major fishing nations, although technological change in the form of substitution of purse-seiner for pole-and-line vessels during the 1980s has substantially raised the expected catch per unit of vessel capacity. We also require a measure of capacity utilisation, which will itself depend on a number of cost, seasonal, and harvesting factors.

Returning to the supply function given by equation (1), it is apparent that in the context of the tuna market obtaining data for just this simple specification is by no means a straightforward task. While the price of tuna may be relatively easy to derive for a given market, factor costs represent a far greater problem. In practice it may be necessary to use a surrogate variable; such as fuel prices, which would reflect some of the variable costs of maintaining a fishing fleet.

Factors Influencing Retail Demand

The demand for tuna in a major industrialised nation will depend on a vast range of interrelated economic, social, and (sometimes) cultural variables. We will now discuss the most important influences:

(i) Price Tuna is sold in both perishable (i.e. fresh) and nonperishable (i.e. frozen or canned) form and thus competes in two allied marketplaces against a range of other fresh and nonperishable foodstuffs. The important price when analysing demand is the relative price, i.e. the price of tuna relative to the prices of all competing products. At a higher level of disaggregation, where the demand for different species of tuna is being analysed, then the relative price will also reflect the different prices of competing species where this is appropriate.

(ii) Consumer Income Variations in a consumer's disposable (i.e. after tax) income will be reflected in subsequent purchasing decisions. After a point, however, additional purchases of a particular food product will be at the expense of another food product since clearly there is a limit on the amount that a person can eat. How this manifests itself in the case of tuna is dependent upon consumer perception of the product. If it is perceived as being merely a cheap substitute for salmon then demand may actually fall as consumer incomes increase, whereas if it is regarded as a more versatile and healthier food than salmon then the opposite may occur.

(iii) Market Promotion Producers use advertising and other means of promotion to both enhance sales and to retain consumer loyalty. It is particularly important in markets such as tinned tuna where a very close substitute exists. By creating an image of the product which allows consumers to differentiate it from the substitute, the willingness to substitute out of tuna may be reduced.

(iv) Image Tuna has a 'young' age group image compared to that of salmon, particularly in view of its dietary benefits and its versatility in cooking. Such images must be carefully nurtured as public tastes and requirements are particularly volatile with regard to 'trendy' foodstuffs. For example, health scares may have a sudden, but long-lasting, deleterious impact on demand. Conversely, health scares associated with salmon may have a positive effect on tuna sales, although consumers may prefer to avoid all tinned fish irrespective of the source of the scare.

(v) Seasonal Factors Consumption of tuna tends to be seasonal, with demand higher in summer than in winter months. Quantification of the extent of such fluctuations should aid producer attempts to raise 'off-season' demand in order to reduce expensive stockholdings.

Using the tools of statistics to analyse both the economic and noneconomic factors that influence the demand for tuna gives rise to a number of practical problems. In particular, how can one measure variables such as 'image' and how can the impact of advertising be evaluated? Clearly these are not unrelated questions. Ideally, we require a surrogate variable to reflect these two factors. If one has the time and resources to use family expenditure survey data, then many of the required social, demographic, and cultural factors that determine demand have already been gathered.

Factors Influencing Tuna Prices

It was noted earlier that changes in the relative level of stocks play a central role in the process of price determination in commodity markets. However, this influence is likely to be of a very short-term nature in markets for perishable commodities. Thus if an exogenous factor led to a substantial increase in tuna supplies then, with stockholding ability relatively restricted, prices would adjust rapidly to ensure market clearance. (Clearly demand-side exogenous 'shocks' would have a similar effect.) This implies that for a realistic model of price determination to be specified, it should be based on data gathered at relatively short time-intervals, say monthly. Annual data may simply bury pertinent short-term factors in consolidated figures. Unfortunately, annual data is the norm in applied economic studies of commodity markets, although a few series are published quarterly or even monthly.

Econometric modelling of seafood markets has been almost negligible, the major exception being a study of the US shrimp market by Doll (1972). In the absence of any major change in real consumer income, his models of price determination are driven exclusively by supply-side factors. Thus retail, wholesale, and ex-vessel prices are expressed as functions of domestic landings, imports, and stocks in cold storage. With the first of these three variables being the most important over the period he was considering (1950–68), prices were effectively being determined by a variable which was considered to be exogenous to the model. Under such circumstances one would expect prices to be relatively volatile, especially if any new technology was introduced which caused a sharp increase in supply or, conversely, if any adverse harvesting conditions occurred.

Family Expenditure Surveys

The lowest level of aggregation that is feasible in practice is associated with economic modelling based on data recorded by household expenditure behaviour surveys. Individual consumer units (i.e. households) are requested to itemise all products purchased over a period of time (usually around 2–4 weeks). On the basis of a large number of returns it is possible to estimate the relative importance of pertinent economic, cultural, and sociodemographic factors on household expenditure patterns.

Consider the determinants of household expenditure on a commodity such as canned tuna during a single time period. Clearly, the price of the product is a relevant explanatory variable, as are the prices of competing products (canned salmon, other fish products, red meat, poultry, and so on) and household income. But noneconomic influences also abound. Clearly, household size (and the number of children) will affect the quantity purchased, and hence expenditure. Tastes and preferences are usually reflected by reference to cultural factors (e.g. religion, race), occupational status (e.g. white collar, blue collar, unemployed), education level, employment status, age structure of the household, geographic region, and urban or rural location. All of these variables, together with seasonal influences, can be entered into an economic model designed to explain household expenditure on any commodity across a chosen population.

In addition to the usual sampling problems associated with family expenditure surveys, there are a number of econometric problems at the estimation stage if the data are used for demand modelling. Nevertheless, as a recent study by Cheng and Capps (1988) has indicated, substantial information on elasticities and key noneconomic influences on demand can be derived from such exercises. Cheng and Capps used data on 9422 households from the 1981 Seafood Consumption Survey conducted in the USA for the National Marine Fisheries Service. The data provided quantity and expenditure information for various species and product forms of seafood for 'at home' consumption only. Since 'away from home' consumption of seafood is estimated to be about 60% of total seafood consumption, this reflects a major shortcoming of the study.

Research Framework

For tuna fish producers, clearly an economic evaluation of the major determinants of consumer expenditure on their product would be of primary importance with regard to sales and promotional programs. However, the world's major markets for tuna (the USA, Western Europe, and Japan) must be treated as separate entities, since each market has its unique characteristics which prevent the three being analysed as a single consuming unit.

The US National Marine Fisheries Service collects statistics relating to a broad range of seafood markets, with series deemed to be of major interest published in the annual 'Fisheries of the United States.' Many of the series date back to 1950 and, in addition, occasional consumption surveys have

been conducted. For Japan and Western European nations, however, a comparable data base does not appear to enjoy such general availability. Data relating to import quantities and values are readily available, but specific marketing details tend to be fragmentary.

Clearly a priority for tuna fisheries research is the establishment of a comprehensive data bank containing information that will allow the key socioeconomic determinants of demand in major markets to be identified and quantified.

Since the USA appears to have a wealth of data on its domestic tuna market, perhaps a pilot study for this market would be appropriate to illustrate what can be achieved by the type of exercise discussed in this paper.

References

Cheng, H., and Capps, O. 1988. Demand analysis of fresh and frozen finfish and shellfish in the United States. American Journal of Agricultural Economics, 70, 533–542.

Doll, J.P. 1972. An econometric analysis of shrimp ex-vessel prices 1950–68. American Journal of Agricultural Economics, 54, 431–440.

Management and Development

Management of the Papua New Guinea Prawn Fishery: An Overview

Robert Vonole[1]

Abstract

The Gulf of Papua prawn fishery has become the leading and major contributor to export earnings in the fishing industry following the closure of the domestic tuna fishery in 1985. PNG exports between 1000 and 1400 t of prawns (tail weight) annually, earning between K8–10 million. The prawn fishery is principally a banana prawn fishery making up more than 50%, with endeavour prawn and tiger prawn groups making up 30% and other minor mixed prawn groups accounting for the remaining 20%. Ninety percent of the prawn catches come from this fishery.

This paper focuses on a need to manage the fishery. A management plan was gazetted in early 1988 as a result of signs of overfishing in 1986–87 when the fishery employed 21 boats which used a mix of quad-rigged otter-trawl nets and the conventional twin-rigged otter-trawl. In 1987 two boats used nonselective small mesh size net of 25 mm with engine capacity of 1200 hp and a total of 23 boats operated in the fishery.

The current management plan has two components of which the first is an immediate requirement designed to allow the fishery to recover, the second is a long-term requirement aimed at managing the fishery better and eventually localising the industry.

Introduction

THE prawn fishery, although very small and fragile, is by far the current most valuable fishery in economic terms. The prawn fishery has become the leading and major contributor to export earnings in the fishing industry following the closure of the domestic tuna fishery in 1985. Total prawn export volume in 1987 was 1468 t, 3% more than in 1986 and worth K9.3 million (K1 = $A1.4 or US$1.1) in export revenue (Table 1).

The prawn resources are mainly exploited by Japanese and PNG nationals, including charter operators. After almost 10 years of relatively stable operation, problems of overfishing began to emerge in 1987. The total catch declined by 262 t from 1321 t in 1986 to 1059 t in 1987. Total banana prawn catch alone declined by 30 t over the same period. With the introduction of 23 boats in 1987, the catch per unit effort of banana prawns, the principal species, declined from 8.6 kg/hr in 1985 and remained at 6 kg/hr in 1986–87 fishing seasons. Figure 1 summarises the catch per unit effort of the Gulf of Papua prawn fishery.

Fisheries biologists in the Department of Fisheries and Marine Resources have observed that the banana species were increasingly caught in small quantities and sizes as reported in the monthly catch records submitted by the companies. Following two consultative meetings, both industry and government agreed that firm management policies be introduced to protect the resource and the industry. Because of the economic importance the government attached to the fishery, the management objective among other things was to ensure that the resource remained an important major export revenue-earning fishery for PNG.

[1] Department of Fisheries and Marine Resources, PO Box 165, Konedobu, Papua New Guinea.

Table 1. Quantity and value of prawn exports from PNG 1979–87.

Year	Quantity exported (tonnes)	Value of exports (KM)	Quantity index (1979 = 100)	Value index (1979 = 100)	Mean fob price per tonne (K'000)
1979	785	3.8	100	100	4,840
1980	980	4.7	124	123	4,795
1981	933	4.6	118	121	4,930
1982	899	4.7	114	123	5,228
1983	1140	8.0	145	210	7,017
1984	1104	6.4	140	168	5,797
1985	1508	9.5	192	250	6,299
1986	1230	9.3	156	244	7,560
1987	1468	9.3	187	244	6,335
Mean 1979–1987	1116	6.7	-	-	5,866

Source: Department of Fisheries and Marine Resources, Inspection Office, Port Moresby, various years.

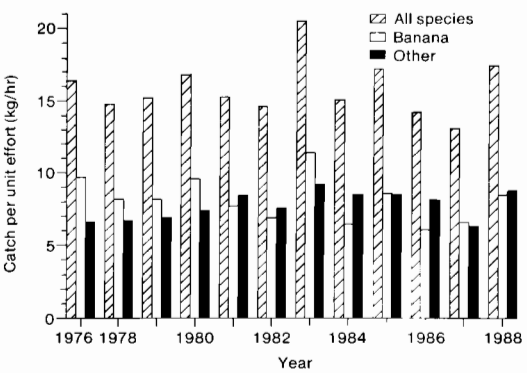


Fig. 1. Catch per unit effort for Gulf of Papua prawn fishery 1976–88. Figures available only up to June 1988.

Background

The history and commercial development of the PNG prawn fishery has been discussed by Doulman and Kolkolo (1985), who have also discussed the initial resource surveys prior to commercial exploitation by fishing companies.

Since 1984 the prawn fishery has become PNG's most important export-earning fishery. Between 1984 and 1987, a total of 5515 t of prawns and lobster were exported at a fob value of K37.5 million. The total fish exports over the same period were about K43.3 million. Prawn and lobster made up 86% of the total fish exports between 1984 and 1987.

Following the closure of the domestic pole-and-line tuna fishery in September 1985, prawns and lobster collectively dominated PNG's fish exports in 1986 and 1987. Prawns and lobster accounted for 89% and 84% of the total fish export value in 1986 and 1987 respectively.

With the prospect of establishing a domestic tuna industry in PNG in the near future looking very uncertain, the prawn fishery will continue to be the major single export-earning fishery until a domestic tuna industry is established.

Resource

The total yield from the prawn fishery is estimated at 1000–1200 t/annum and is composed of three main species groups, banana prawns (*Penaeus merguiensis*, *P. undicus*), black tiger prawns (*P. monodon*), tiger prawns (*P. semisulcatus*) and endeavour prawns (*Metapenaeus ensis*, *M. demani*, *M. eboracensis*). Opnai (1987) stated in a recent assessment of the fishery that the catch composition of species from the Gulf of Papua prawn fishery is: banana prawns 54%, black tiger 7%, tiger 1%, endeavour 19% and the minor mixed prawn groups make up 19%.

The banana prawn, the most important species in both quantity and value, has an estimated yield of 500–600 t/annum.

Fishing Area

The Gulf of Papua prawn fishery extends along the coast from the mouth of the Fly River in the west to Iokea in the east and extends seaward to the 40 m contour. This area covers the waters adjacent to both the Gulf and the Western Provinces. The total area trawlable is around 9603 km^2 although only 1388 km^2 receives over 50% of the total fishing effort. These areas include Orokolo Bay, Kerema Bay, Freshwater Bay and the Lakekamu estuary (Fig. 2). The localised operations reflect the stock density and also the fact that these areas are more sheltered than areas to the west which experience

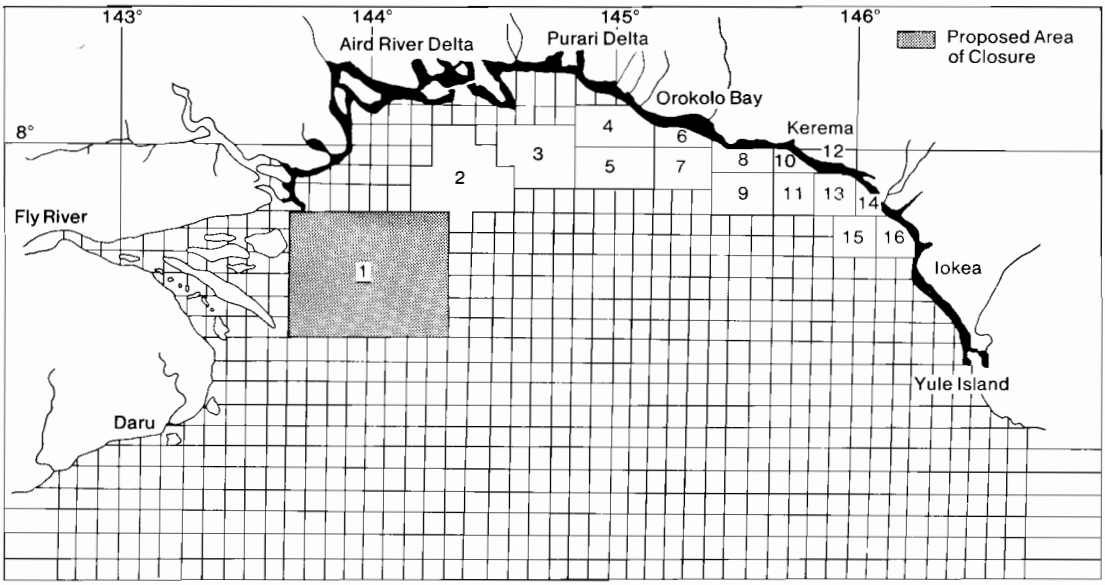


Fig. 2. Fishing areas in the Gulf of Papua: 1. North Fly Bamu, 2. Turama, W. Cape Blackwood, 3. East Cape Blackwood, 4. Purari Inshore, 5. Purari Offshore, 6. Orokolo Inshore, 7. Orokolo Offshore, 8. W. Kerema Bluff Inshore, 9. W. Kerema Bluff Offshore, 10. Kerema Bay Inshore, 11. Kerema Bay Offshore, 12. Fresh Water Bay Inshore, 13. Fresh Water Bay Offshore, 14. Lake Kamu Est. Inshore, 15. Lake Kamu Est. Offshore, 16. Iokea C. Procession.

rough weather conditions throughout most of the year. The main grounds for banana prawns are Kerema Bay and Freshwater Bay.

Fishing Operations in the Fishery

The fishery has been in commercial operation since 1967. However, detailed catch records are only available from 1977. In 1976, three companies operating were allowed four licences each, by recommendations from the then Division of Fisheries of the Department of Primary Industry. This measure was used to prevent overexpansion of foreign interests and encourage the formation of joint venture as well as to protect the stock. In 1978, two old vessels were commissioned by a joint ventures company to fish inside the 3-mile limit. During the same year an ageing trawler returned to Japan and was not replaced. In 1981, four national companies chartered vessels to operate inside the 3-mile limit, making a total of 19 vessels. Apart from 1981, the average number of vessels operating in the Gulf of Papua prawn fishery had been 13–14.

Results of the prawn resource study carried out between 1977 and 1979 showed that the maximum number of vessels to maintain the fishery at a sustainable level would be 15. In maintaining this number of vessels, the fishery had been relatively stable. During 1986, the number of licenced operators increased to 21 with the introduction of Australian chartered vessels. The increased number of vessels meant that the operators had to either increase their fishing efficiency or direct their effort to catching more of the valuable species to remain viable. While the Australian vessels used quad-rigged otter-trawl nets, instead of the conventional twin-rigged otter-trawls, at least one Japanese operator paid higher bonuses to their crews for higher catches of banana prawns. Prawn being a finite resource, the increase in effort and efficiency did not show significant increase in the total catch as well as catch rates. Total catch over the 11 years has ranged between 1100 and 1200 t/annum.

In 1987, the number of vessels fishing was further increased to 23, of which seven were using quad-rigged gear, while two vessels were each powered by a 1200-hp engine to pull highly nonselective smaller (2.5 cm) mesh-size nets. This increase in effort and gear changes coincided with disappointing overall catches. The poor catch per unit of effort was the result of increase in effort, and possibly an additional seasonal effect.

Exports

In 1986, PNG exported a total of 1417 t of prawns (tail weight), 21% less than in 1985. Of the total PNG prawn exports in 1986, 77% (1103 t) of the exports went to Japanese markets, 22% (320 t) entered the Australian market, and the remaining 1% went to the United States and Singapore markets.

The Japanese market has become a major and important one for PNG because of the Japanese companies' involvement in the industry. PNG has strengthened this market by its desire to increase foreign exchange earnings from the export of its prawn resources.

The total value of prawn exports from PNG is estimated at between K8–10 million/annum. In 1986 the fob value of PNG's prawn exports totalled K8.9 million, 4% less than in 1985 (K9.3 million).

The average export price of PNG's prawn exports is US$9.12/kg. Prawn prices ranged from US$10.20 for banana and tiger prawns to US$3.30 for the low valued mixed prawn groups.

Marketing and Charter Arrangement

Currently, prawn companies operating in PNG have a well-established market for their products with their major shareholders, marketing agents and trading partners in Japan. The marketing arrangements between PNG-based companies and their trading partners are strengthened by agreements on the sale of the products, commission and profit sharing arrangements among the local subsidiaries and overseas trading partners. Such marketing arrangements thrive on producing and securing a reliable prawn supply for the large well-established Japanese market available to absorb PNG prawn exports.

Price and control of the product are essential elements of marketing. Examination of the possibility of separating catching and marketing suggests that in the current situation it would prove difficult. Therefore, existing marketing arrangements through parent companies will be permitted. The critical aspect in appraising marketing arrangements will be control of the product, in that priority will be given to companies that are free to market product independent of other aspects of marketing which was quite difficult to handle under charter arrangements.

A number of vessels in the fishery were operating under wet charter arrangements under which the locals are the licence holders. These charters are usually linked to the product, leaving the local partner with very little control over the operations and management of the boats. An apparent result of this has been price manipulation by boat operators and, therefore, financial loss in terms of revenue for the local partner.

Despite this, charter arrangements like the above provided an opportunity for local businessmen with little capital to go into prawn fishing. Application for licences increased dramatically from locals who entered charter arrangements with foreign boat owners. With the long-term objective to localise the prawn industry, the government was forced to issue more licences to meet the increased demand for licences by locals.

During the 1986–87 season, seven national companies operated 20 boats under charter arrangements. Total number operating was 21 in 1986 and 23 in 1987. This was a drastic increase from 14 in the 1984–85 season and 11 in 1982–83 when operations in the fishery were regarded as being more stable.

This increase in the number of licences issued and the subsequent number of boats allowed to operate in the fishery resulted in evident signs of overfishing with declining catch per unit of effort and reduction in size of prawn caught. In view of this, the government introduced the management plan as a measure of protecting the Gulf of Papua Prawn Fishery, to keep the industry profitable and to allow the resource to be exploited in a biologically sound manner.

Management Objectives

The management program was implemented in the prawn fishery with the following objectives to ensure that the:

(i) resource is harvested in a biologically sound and economically viable and profitable manner;

(ii) prawn fishery is protected from overexploitation so that the resource is restored and used in an orderly manner;

(iii) resource remains an important major export revenue-earning fishery for PNG;

(iv) national interest in the fishery is protected; and

(v) resources will be available for future generations.

The Management Plan

The Government-introduced management plan for the Gulf of Papua was gazetted in February 1988. The plan was based on the analysis of the catch data and discussions held between the industry and the Department of Fisheries and Marine Resources.

The management program will be in two phases. The first is to be implemented immediately to facilitate recovery and to safeguard the resource; the second will be a long-term plan to manage and ultimately localise the prawn industry.

The catch data analysed indicated the resource being fished beyond the predicted maximum sustainable yield during the period 1986–87. Because banana prawn is an annual species, the effect of the 1987 effort and catches was experienced in the 1988 fishing season. To prevent further depletion of the resource, the Department of Fisheries and Marine Resources recommended the implementation of the following management guidelines in the 1988–89 fishing seasons:

(a) *Reduction in Fishing Effort*
The Department recommended that the number of licences for the 1988 and 1989 seasons be limited to 15 with the following restrictions until the stock shows evidence of full recovery.

(b) *Gear Restriction*
With the increase in the number of vessels, there is also an increase in competition which prompts the operators to become more efficient to remain viable. Unfortunately, the improvement of fishing efficiency by some operators may lead to unscrupulous overfishing. The Department recommended the following restrictions on the size of gear used in the harvesting of prawns:

(i) the vessel sizes to be limited to 30 m length overall;

(ii) the main engine shall have a maximum shaft power of 315 kW as set out in the manufacturer's specifications;

(iii) the maximum number of nets to be towed at any one time shall be two main nets and one try-net;

(iv) each length of the foot rope and head rope for the main nets shall be greater than 28 m and for the try-net 6 m;

(v) the size of the meshes for all nets used measured diagonally from knot to knot shall be equal to or greater than 50 mm at the body and 45 mm at the cod-end.

(c) *Area Closure*
Biological studies and information from the industry have indicated that there are areas which could be critical to the prawn resource. These are the spawning and nursery grounds. The areas which are particularly important are Area 1, the Fly area; and inside the 3-mile limit particularly the Orokolo Bay between the east bank of the Purari delta to the Bluff east of Vailala River (Fig. 2). The following were recommended regarding the area closure until the Department completes a 12-month survey to identify which areas hold fully recruited adult prawns and can be opened up to commercial trawling.

(i) For the purpose of protecting the nursery grounds, no trawling shall be allowed inside the 3-mile limit from the Fly River estuary in the west to Point Suckling in the east.

(ii) For the purpose of protecting a major spawning stock, no fishing shall be allowed in the Fly River estuary from 1 April to 30 September in any one year.

The Department is intending to localise the prawn fishery in the long term by declaring it a limited entry fishery and unitising the fishing effort. Licencing criteria have been worked out for future consideration of licence applications following the guidelines outlined in the above management plan of the fishery.

Licencing Criteria

Consistent with the objective of localising the prawn fishery, national companies will be given preference in the issuance of licences. However, it must be stressed that only companies committed to long-term development of the fishery will be licenced. The prawn industry must remain stable and profitable and therefore all licence applications will be carefully screened. In particular information will be sought in the following:

(a) Companies applying for licences must have sufficient capital to finance their fishing operations. Therefore full company accounts must be provided giving details of asset backing, equity and liabilities.

(b) Details of vessel ownership or charter arrangements must be provided. If vessels are

chartered then the charter should run for at least 3 years unless it is planned to replace the chartered vessels with purchased vessels.

(c) Details of marketing and transshipment arrangements must be provided to ensure that income and spin-off benefits generated from the fishing operation remain in Papua New Guinea.

(d) Details of shareholding in the company must be provided to confirm the level of local ownership.

(e) Details of fleet management and shore-based facilities to be used must be provided. This is to provide evidence that the licence holder can adequately operate the trawler and fleet and market the catch independently.

Nationalising the Industry

The only two major developments which occurred during 1983 in nationalising the PNG prawn industry were the Government's acquisition of 33.17% share equity ownership of New Guinea Marine Product and the termination of the joint venture arrangement between Gulf Marine (now Gulf Papua Fisheries) and Pacific (now Pacific Seafoods) leading to full local ownership of Gulf Papua Fisheries by the Gulf Provincial Government.

There are two possible options for increasing local ownership of the prawn fishery. Firstly, new companies may be granted entry to the industry at the expense of existing foreign companies. The second option is for local investors to negotiate the purchase of equity in existing foreign companies. As part of this policy the Government is valuing its share equity of 33.17% in New Guinea Marine Products as a prelude for sale to interested and capable national investors. The national company can at the same time utilise on commission basis the marketing and technical expertise in these already well-established companies. To effectively implement this option, a comprehensive nationalisation time schedule has to be drawn up to monitor progress and development in the prawn industry.

It should be pointed out that for any successful operation in the prawn industry, potential national companies should maintain Japanese technical, management and marketing expertise for the operation to become profitable. At the same time, efforts should be made for nationals to be trained for localising positions at all levels including management level of existing foreign companies. A schedule of up to 3 years to achieve substantial localisation of ownership in the industry may be highly optimistic unless a meaningful localisation program of the industry is drawn up.

In the case where new national companies enter the industry it may be possible for them to come to commercial arrangements with existing foreign companies for the leasing of vessels and provision of management expertise.

At least two foreign companies in the fishery have taken steps to reduce their level of foreign ownership. The issue of foreign ownership is not crucial to the management of the fishery, although there are economic considerations relating to benefits from marketing and control of the resource. Until Papua New Guinea develops an independent marketing capacity, there will be some benefit in retaining links with Japanese companies providing that adequate price surveillance is maintained.

Acknowledgments

I would like to thank Mr M. Chapau, Acting First Assistant Secretary for Resource Development and Enforcement, for his comments and support in preparing this paper and Miss J. Aris for typing the report.

References

Doulman, D., and Kolkolo, U. 1985. PNG's prawn fishery small but valuable. Australian Fisheries, 44(4), Australian Government Publishing Service, Canberra.

Opnai, J. 1987. The Gulf of Papua prawn fishery: A summary of the biological and catch and effort data analysis to-date and some guidelines for an interim management plan. Department of Fisheries and Marine Resources, Port Moresby.

Development of Ocean Fisheries in Vanuatu

M. Riepen and D. Kenneth[1]

Abstract

This paper describes and traces the historical development of Vanuatu's involvement in the exploitation of oceanic tuna resources. It outlines the government's policies and the role of the South Pacific Fishing Company in the development of oceanic resources. A brief description and an analysis of the development strategies available to Vanuatu are included. Conclusions are drawn which stress the importance and the need for more economic and strategic analyses to be undertaken prior to the implementation of any given development option.

Introduction

THE Republic of Vanuatu consists of an irregular Y-shaped chain of approximately 180 islands extending over more than 800 km and has an Exclusive Economic Zone (EEZ) covering approximately 800 000 km^2. It is situated between 13 and 22°S and 165 and 177°E.

The land area is 12 190 km^2 with a population of approximately 144 900, of whom the majority are Melanesian, Ni-Vanuatu (Anon 1988). The economy is mainly agrarian with more than 80% of the population living in rural areas. The principal exports are copra, beef products, cocoa, and timber. A substantial contribution to the economy has been made by fisheries with the reexport of frozen tuna, mainly albacore and yellowfin.

National Development Objectives

Prior to independence, there were no strategies for fisheries development in Vanuatu. Fishing activities were mainly subsistence in nature, with low production from traditional harvesting of the shore and reef areas, either on foot or from canoes. Commercial sales of fisheries products were confined to the urban areas, where sales were generally made to shops and supermarkets.

The First National Development Plan (1981–86) for the country saw the Government's policies in oceanic fisheries as:

i) The development of a locally based industrial-scale fishery to exploit the tuna resources within the Republic's 200-mile exclusive zone, and

ii) The development, where appropriate, of domestic tuna processing facilities (Anon. 1981: 147).

The Second Development Plan (1987–91) for fisheries was to consolidate gains achieved under the First National Plan, and where possible to diversify into areas which in the past had received little or no priority. For oceanic and industrial fisheries, the main objective was to begin the development of a small locally based ocean tuna fishery as well as reviving the industrial fishing base recently acquired by the Vanuatu Government (Anon 1986: 16).

South Pacific Fishing Company (SPFC)

The only large-scale commercial fishing activity conducted in Vanuatu was from Palekula by the South Pacific Fishing Company (SPFC). The SPFC

[1] Vanuatu Fisheries Department, Port Vila, Vanuatu. The views expressed are those of the authors and are not necessarily those of the Vanuatu Government.

was established in 1957 as a transshipping, cold storage and fishing support base for the Japanese longline fleet operating in the West Pacific targeting on albacore for the canned white meat market in the United States. The major facilities at Palekula include unloading and transshipping wharves, a 2508 t cold store, two slipways, workshops, a fishing gear store and fuel bunkering facilities. The major shareholders until 1987 were Mitsui and Company from Japan with 76% and the Government of Vanuatu holding a 9% share. Since then the government has acquired total ownership of the base (Anon 1983: 17).

The SPFC has been host to a number of foreign fishing fleets over the years. Since its establishment in the mid 1960s, the Japanese longline fleet supplied the base. They were then replaced by Koreans and by the mid 1970s Taiwanese longline vessels dominated the fleet. In 1986 the base ceased purchasing tuna for a number of reasons, including the depressed albacore market. The facilities have not been fully utilised since. However, the Vanuatu Government is strongly in support of recommencing large-scale transshipping and cold storage operations at the base. The government is looking to foreign tuna fishing and/or processing companies to operate and manage the facility. Several proposals have been received which are currently being reviewed and evaluated. Although no vessels are currently supplying fish to the base, there were 48 Taiwanese vessels licenced through SPFC to fish in Vanuatu's EEZ during 1988. These vessels supply the canning and transshipping facilities in Fiji and/or American Samoa. The number of boats contracted to SPFC, employment of Ni-Vanuatu crew, the amount of fish landed and the value of reexported fish are shown in Table 1.

The number of fishing boats licenced to fish in Vanuatu's EEZ increased from 1970 to a peak of 65 in 1980. The number subsequently declined and in 1986 no further contracts were made for vessels to supply the base. The Ni-Vanuatu crew employment scheme commenced in 1981 and the number has increased dramatically since and is now in excess of 140 Ni-Vanuatu employed as fishermen aboard Taiwanese vessels. The quantity of fish landed was at its highest in 1972 with just under 16 000 t. Quantities subsequently reduced but rose slightly towards the latter 1970s, and during the 1980s landings again declined. The value of reexports was at an all time high in 1978 with a total of US$12.5 million.

Table 1. Number of boats contracted to SPFC, employment of Ni-Vanuatu crew, the amount of fish landed and the value of reexported fish.

Year	No. of boats	Ni-Vanuatu crew	Fish landed (t)	Fish reexport (US$000)
1970	26	*	9 240	2 274
1971	45	*	13 403	6 780
1972	55	*	15 598	8 162
1973	57	*	15 131	8 520
1974	67	*	9 424	7 460
1975	46	*	5 218	3 330
1976	28	*	6 091	5 341
1977	55	*	9 997	11 166
1978	48	*	9 182	12 560
1979	50	*	7 724	12 460
1980	65	*	6 932	11 990
1981	45	13	4 523	8 070
1982	28	33	3 863	7 664
1983	14	46	5 030	8 072
1984	18	37	3 906	7 303
1985	14	57	4 032	7 116
1986	6	22	1 186	3 813
1987	15	54	0	0
1988	33	120	0	0

*Ni-Vanuatu employment scheme not in operation (source: Anon. 1987).

Table 2. Revenue sourced from export tax and foreign licence fee.

Year	Export tax (US$)	Licence fee payments (US$)
1970	79 650	3 900
1971	129 884	6 750
1972	159 094	7 800
1973	228 620	8 550
1974	239 911	10 050
1975	105 571	6 900
1976	130 700	4 200
1977	307 950	8 250
1978	241 434	7 200
1979	181 890	7 500
1980	185 395	9 750
1981	383 285	6 750
1982	302 359	1 350
1983	157 888	2 552
1984	180 243	3 100
1985	137 330	2 301
1986	55 329	539
1987	28 230	1 556 920
1988	6 820	215 808

(FFA 1982 report, p. 5 and Accountant General's department.)

The source of revenue for government from the operation of SPFC has been through the imposition of an export tax. The amount of revenue sourced from SPFC in the form of export tax on fish exports and that directly obtained from foreign vessels through licencing is shown in Table 2. The revenue source from the imposition of export tax on fish

was at its highest in 1981 when a 4% rate applied to all fishing landings and a total of over US$380 000 was collected. Collections since have declined very rapidly and the rates reduced, and now only a rate of 4% applies to fish caught within the 12-mile territorial zone. Foreign fishing licence fee levels were very low for vessels fishing into SPFC and in total never exceeded US$10 000 at any time during the 1970s. The relatively high fee payments since 1987 are due to a fishing agreement with the USSR and increasing fee levels for Taiwanese vessels fishing in Vanuatu but unloading catch in a foreign country.

Approach to Oceanic Development

Vanuatu, being a relatively late player in the development of its marine resources, has witnessed many of the problems encountered by other Pacific states in the establishment of national tuna fishing operations. Vanuatu has therefore adopted a cautious approach to oceanic fisheries development. The ever-changing market conditions including tariff and nontariff barriers combined with the expansion of fishing and low-cost processing by certain Asian countries have been powerful constraints on local development.

The SPFC base in Palekula provides us with an ideal medium to expand our involvement in the oceanic fishery and any plan to establish a national fishing operation will certainly be developed on that basis. The geographical location of Vanuatu is conveniently close to the highly valued Coral Sea albacore fishery. However, we are a little too far south to enjoy the great abundance of surface skipjack and yellowfin resources available to Solomon Islands and PNG. The lack of reliable baitfish resources precludes us entering into the pole-and-line fishery and, given the costs and risks associated with purse-seine development for an unknown fishery, this option cannot be considered unitl the SPC have completed the regional purse-seine project and results indicate such an option is viable on a national scale.

Our options are therefore limited to one or a combination of the following development strategies:

a) Operate a national longline fishing fleet targeting albacore;
b) Servicing fishing fleets operating in or close to Vanuatu including the purchase of catch and possibly onshore processing;
c) Licence foreign fishing nations to fish our resources.

National Fishing Fleet

A number of issues must be addressed when looking at this development strategy. What will the benefits be to Vanuatu? Should we consider requesting aid for such development or should we buy or build our own national fishing vessel? What type, size and design should the longline fishing vessel be to be most appropriate for Vanuatu, in terms of commercial viability and the provision of the most benefits to the country and its people?

The longline fishery is Vanuatu's most valuable fishery and it generates the highest fisheries revenue flow for government. Given the long involvement of foreign longliners in Vanuatu waters, will it be economically viable for Vanuatu to own and operate one? It is often a mistake to think that because foreign fishing nations operate vessels in our waters we are able to operate in a similar manner and even more importantly do it profitably. There are, unfortunately, several examples of Pacific states operating or having operated vessels in the region which for a number of reasons have not been viable. In Solomon Islands two *sashimi* longline vessels were operated for several years by the national fishing company NFD. These vessels had similar catch rates compared to the Japanese fleet and received similar market prices for the catch. However, these vessels did not even operate on a cash break-even basis and both vessels have since been sold and are now squid fishing in New Zealand.

One of the '*considered*' most successful and longest surviving national longline vessel operating in the region is MFV Lofa, the Tongan-owned albacore longliner. This venture is a credit to Tonga, however, we question its long-term economic and financial viability. The vessel has generated good operating cash profits, but revenue levels in total are not sufficient to allow for vessel replacement at the end of its economic life. The cost structure also does not reflect the true operating costs, specifically interest or management overhead costs, as the vessel was provided under an aid grant and vessel management is done by government-paid staff.

The acquisition of a longline vessel and operation of a national fishing fleet is still Vanuatu's long-term objective. However, we do not believe it is timely to do so in the current operating environment. The competition from the Asian low-cost structured longline fleets is still a constraint and, given the recent problems over the management of the southern albacore fishery in regards to the gillnetting of juvenile fish (estimates from the

scientific community suggest that current levels of exploitation are several times the long-term MSY), it would be unwise to enter a fishery which may be uneconomic and, even more sadly, have totally collapsed within a few years.

Servicing and Support of Fishing Fleets

The second option for Vanuatu is to continue to operate the SPFC as a service and support base for various fishing fleets operating in or close to Vanuatu. At present there are very limited servicing and support centres in the South Pacific and the costs of establishing them are prohibitive considering the size of national fishing operations. The Vanuatu Government owns the SPFC base and is benefiting from revenue generated from the use of slipways, cold storage facilities and the provision of crew to Taiwanese longline vessels fishing in the Pacific and Indian oceans. SPFC also acts as agent for Taiwan vessel owners to obtain licences to fish in Vanuatu's EEZ.

Although the Vanuatu Government owns the base, it does not view ownership of the base as critical. The Vanuatu Government has not invested much money in the base as it believes this, together with the operation and management of the facility, is best left to foreign investors and distant water fishing nations at least in the medium term. Decisions therefore regarding onshore processing and canning are issues which must be considered in collaboration with foreign investors and management operators. It is, however, unlikely that in the near future canning or other advanced onshore processing would be internationally competitive in Vanuatu due to our higher operating cost structure relative to the Asian canneries and the USA tariff and nontariff barriers that apply to the white meat tuna market.

The government strongly supports continuing and expanding operations at SPFC. Use of the facilities by other South Pacific national fishing operations is also encouraged. The development of this strategy therefore rests with securing foreign investment and tuna fishing/processing companies to operate and manage the facility.

Licence Foreign Fishing Vessels

This strategy is to continue to negotiate for other foreign vessels to fish in Vanuatu waters through payment of licence fees. This is a realistic and practical strategy and one which tends to be underrated. At the moment the government is benefiting from revenue derived from the fees from foreign vessel operators, namely the USA and USSR, for purse-seine fishing and Taiwanese boatowners for longline fishing. Vanuatu has signed and is about to ratify the USA Multilateral Fishing Agreement which will contribute nearly US$200 000/annum plus additional fees if any catch takes place in Vanuatu. The Fishing Agreement with the USSR for 1987–88 was for US$1.5 million and further access negotiations for a new agreement are now in progress. Taiwanese longline vessels currently pay US$5000/vessel/year for vessels fishing in Vanuatu but unloading catch in a foreign country. Vessels fishing into SPFC would receive a substantial discount on such fees. The Taiwanese fishing vessels also employ Ni-Vanuatus as crew members. Referring to Table 1, the increasing employment figures indicate the increasing interest by Ni-Vanuatus as crews for longline fishing. Foreign exchange earnings from this employment are currently around US$500 000/annum. This employment also provides Vanuatu with a resource of qualified and experienced longline fishermen on which to base any development of a national fishing operation.

Therefore given this, one can see from Table 2 that revenue earned from licence fees has increased considerably over the last 2 years. However, this strategy makes Vanuatu dependent on distant water fishing nations to exploit its oceanic resources which in the long term is contrary to our stated national development objectives.

Conclusion

Vanuatu has not actively participated in the development of its oceanic resources and has left the exploitation, operation and management of fish transshipping facilities and marketing to the commercial interests of the distant water fishing nations. Significant contributions have, however, been made to the economic development of the country — export taxes, licence fee payments and other charges do make a significant revenue source for government. Employment in excess of 130 Ni-Vanuatu aboard foreign fishing vessels provides substantial overseas earnings and is one of the largest employers of labour in Vanuatu. All this has been at little or no cost to government, and has not required investment or the use of aid funds which are therefore available for alternative development projects.

Vanuatu is in the initial stages of planning its national entry into the oceanic fishery. However, we are not yet convinced that it will improve the economic returns to the country. The track record of other developments in the region is not very positive. It seems that many of the decisions in the past have been at least partially based on suggestions from aid or soft loan development organisations. These at times have been supported by consultant advice of questionable value. It is therefore little wonder that many national fishing operations in the region have gained little benefit.

We would like to see countries like Vanuatu be provided with a well-structured economic evaluation of all development strategies available to develop the oceanic resources of our EEZs. Such evaluation and study should provide countries with a checklist of the real and opportunity costs and benefits (economic and noneconomic) of each development strategy which can then be used in the evaluation of specific projects or proposals. We would prefer not to see Vanuatu's name added to the list of countries that have established national fishing fleets which, in fact, provide a negative economic contribution to the country's development and/or become ongoing drains on government funds.

References

Anon. 1981. Fisheries. In: First National Development Plan 1982–86, Port Vila, National Planning and Statistics Office, 147–156.

1982. Report on the Operations of the South Pacific Fishing Company, Honiara, Forum Fisheries Agency, 65 p.

1983. Fisheries Department 1981–82 Annual Report, Port Vila, Fisheries Department, 18 p.

1986. Fisheries. In: Second National Development Plan 1987–91, Port Vila, National Planning Office, 24 p.

1987. Fisheries Department 1986 Annual Report, Port Vila, Fisheries Department, 22 p.

1988. Vanuatu, Fishery Country Profile, Food and Agriculture Organization of the United Nations FID/CP/VAN, 5 p.

Australian Tuna Fleet in the Western Pacific: Implications for Industry and Fisheries Management

Alistair McIlgorm[1]

Abstract

The recent severe reductions in Total Allowable Catch for southern bluefin tuna have forced operators to consider alternative tuna fisheries in Australia and the Western Pacific. Australian operators gained access to Solomon Islands, Papua New Guinea and the Federated States of Micronesia, the traditional tuna grounds of the Western Pacific. However, logistic, technical and financial factors will have implications for industry, fishery management and research. The Australian fleet does not have the capacity or size of an established distant water fishing nation (DWFN). The typical vessel is inappropriate for purse seining, but the largest southern bluefin tuna boats could be converted. Ex-DWFN vessels have been purchased and are more suited to the Pacific operation.

Financial models are used to estimate investment viability. Financial tuna fishing models are reviewed and one is adapted to Australian operational cost data. Price versus catch rate curves are employed with operational sensitivity techniques to see implications for vessel profitability and access costs in the region. The potential of Australian fishing vessels operating in the Pacific is examined, and regional implications and potential research issues are identified.

Introduction

THE southern bluefin tuna (SBT), *Thunnus maccoyii*, in waters to the south and east of Australia has been fished since the early 1950s. Individual Transferable Quotas (ITQs) and reductions in Total Allowable Catches (TACs) have forced operators to consider other fisheries. Alternative tuna species in the Australian Fishing Zone (AFZ) have shown limited promise and entry to the Pacific tuna fisheries began in 1988. Western Pacific purse seine tuna fishing, however, involves technical and financial constraints. Issues raised by the move are important to future fisheries management and industry development in the Pacific region.

[1] Fisheries Economist, School of Fisheries, Australian Maritime College, PO Box 986, Launceston, Tasmania 7250, Australia.

Australian Bluefin Tuna Fleet and Alternative Fisheries

The SBT fleet uses pole and line, trolling and purse seine fishing methods. The majority of vessels are owned by companies forming the Tuna Boat Owners Association of South Australia (TBOASA).

ITQs were introduced in 1984 causing readjustment in the numbers of boats and fishermen (Geen and Nayar 1988). Scientific evidence that the SBT stock was showing signs of overfishing (Hampton and Majkowski 1986) was reinforced in 1987 and 1988 with cuts in quota, and calls for a moratorium, in the face of possible extinction (Cribb 1988). Alternative fisheries in Australia and the Pacific needed to be investigated.

Of nontuna alternatives, Tasmanian jack mackerel, used for reduction to fish meal, is a seasonal fishery with limited potential. Within the

AFZ, surveys on the west and northwest coasts found tuna not to be in commercial quantities (Barwell 1980). Skipjack, yellowfin and the other Pacific tuna species occur on the east coast where there is a longline fishery. The stock sizes are relatively unknown, the information that exists being gathered through the South Pacific Commission's (SPC) Tuna and Billfishes Program and Australian federal and state government agencies (Kearney and Gillett 1979; Williams 1984). The Coral Sea region within the northern AFZ may be suitable for a potential purse seine fishery, though industry doubts it would support a 500 t tuna operation (tonnes in this paper refers to fish carrying capacity in metric tonnes).

Pacific Island Tuna Resource

Four major tuna species (skipjack, *Katsuwonus pelamis*, yellowfin, *Thunnus albacares*, bigeye, *Thunnus obesus*, and albacore, *Thunnus alalunga*) are found in the Western Pacific area and have been fished by pole-and-line fleets, longliners and purse seiners. From the work of the SPC's Tuna and Billfishes Program, the areas with the most potential for purse seining appear to be to the north of PNG, Solomon Islands and the Federated States of Micronesia (FSM). These are the recognised purse seine grounds for tuna in the Western Pacific and are shown in Fig. 1 (SPC 1988).

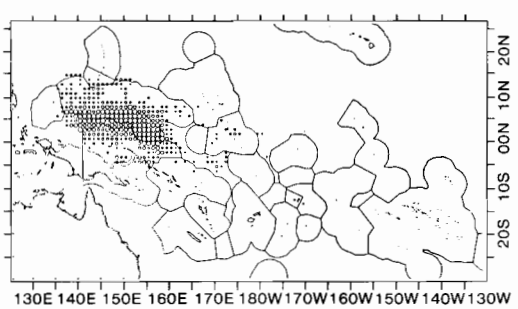


Fig 1. South Pacific Commission purse seine effort data for the first half of 1988.

Access to the Pacific Tuna Fisheries

Vessels intending to fish must apply to the Forum Fisheries Agency's (FFA) register of foreign fishing vessels and the government concerned to gain the details of their licencing policy. In the case of PNG the model for foreign vessel access is the PNG/Japan Fisheries Agreement. This is a nondiscriminatory open door licencing policy in which any vessel owner who is prepared to pay the prescribed fee and observe the terms of the agreement is eligible for entry. Fees are related to fish caught per period of time (Doulman 1987a).

Several approaches to Papua New Guinea by the Tuna Boat Owners' Association of Australia (TBOAA) in 1987 and 1988 produced trial short-term access periods of 2 months. TBOAA wish to secure a longer term, more comprehensive agreement in the future. In 1988 the first Australian vessel, Bluefin Exporters' 'Bluefin Conquest' (500 t), and later Stehr group's vessel, 'Tasman Dawn' (300 t), gained access to the Solomons and then Micronesia. 'Tasman Dawn' had previously fished SBT and illustrates some limited potential of converting an ex-SBT purse seiner. The rest of the SBT fleet are smaller pursers or pole-and-line vessels unsuitable for Pacific purse seining. Thus companies have bought ex-DWFN vessels, such as 'Bluefin Conquest' or built/converted other vessels. The ex-DWFN vessels have to date been more successful than the boats and crew with SBT experience. The reasons for this are primarily technical.

Technical Constraints

Fishing for the tuna species of the Western Pacific is a much more technically precise 'industrial' fishery than SBT needing catching expertise and appropriate equipment. A United States purse seiner (1200 t) is bigger than either the largest ex-SBT boat (300 t), or ex-DWFN vessel (500 t). This lack of vessel capacity affects the size of net that a boat can use, which is critical to catch rates, as Pacific tuna species are fast moving and need a deep net, particularly if daylight fishing is to be successful. Knowing this, vessels have found that new nets were still not deep enough and fish escaped during the critical purse closing stage. With such nets costing approximately A$600 000, purse seining in the Pacific is an expensive fishery to enter.

Refrigerated hold capacity is critical for operations (Stehr 1984). Working in the tropics means refrigeration systems must be designed with overcapacity as breakdowns can delay fishing and thus be costly. Similarly, operators have had to be aware of differing pollution legislation between countries in the region.

The ex-DWFN vessels have been imported and registered as Australian vessels, encouraged by the relaxation of import regulations (Reilly 1989). Australian shipping legislation requires the skipper to have a master class three fishing qualification.

Larger fishing vessels requiring this qualification have not been common in Australia and so few Australian masters have adequate qualifications and experience in catching Pacific tuna.

Australians now believe that ex-DWFN vessels are more suitable as purse seiners. Optimum vessel size will be influenced by many factors. Te Mautari (1985) found 'home port to fishing grounds distance, oceanographic conditions, fish school size, economic performance, shore infrastructure and flexibility of operation' are all factors. TBOAA confirm an international trend towards 1000 t vessels. Modelling costs of various scales of purse seining operation may help to choose the optimal vessel size. Operation structure has changed in recent years with transshipment at sea increasing. Delays around ports, caused by having to wait to unload, take on water, fuel and food supplies are to be avoided. Transshipping at sea is favoured to avoid such 'bottlenecks' and hence the loss of fishing days. Delays with transshipment involve waiting for reefer vessels and unloading problems.

A new entrant in Pacific purse seining has a 'learning curve' to climb as rapidly as possible. This can be an expensive process.

Financial Models of Tuna Operations

The use of financial modelling of prospective operations, incorporating technical constraints, must be an essential part of feasibility planning and financing of a new venture. For management, Beddington (1985) states 'Clearly for the purposes of both negotiation and for informed decisions about management strategy it will be necessary to analyse the way in which catch rates affect the profitability of the fleets. This sort of analysis involves the construction of financial models of the different types of operation.'

Modelling Methods

Electronic spreadsheet packages are available for most personal computers and are used for financial modelling. Cells can be interlinked using formulae to produce an appraisal which can perform quite complex repetitive calculations as designed by the user.

Operation Modelling

For a given fishing method details of operational criteria can be assembled to reflect operational practice. Such changes have cost and revenue implications and can be examined through a traditional financial appraisal framework.

Purse seine and longline financial appraisal models were designed within the Forum Fisheries Agency (Anon 1985a; Kida and Phillipson 1988). For purse seine fishing 'Various aspects of the vessel's operations are reported on by the model...the cash flows over the vessel life, an investment appraisal, and a financial accounting report...parameters of the vessel's operations such as vessel cost, catch rates, vessel size, crew costs, etc. can be altered as frequently as desired...and the impact of these alterations is automatically determined by the model's successive re-calculations' (Anon. 1985a). Table 1 is my reconstruction[1] of the figures as given in Anon. (1985a) for a United States 1200 t vessel with helicopter. Financial appraisals of prospective fishing projects in the Pacific compiled by consultancies exist, but few have accommodated operational changes. Financial models are also used by tuna project financiers to assess a proposed venture from the lender's point of view (Skapin and Pintz 1987).

Adapting the FFA Model

For a prospective Australian venture, smaller vessels with significantly different operating patterns required adaptation of the FFA model. The Australian vessels would transship catch at sea as opposed to travelling long distances to home port. An appropriate model was constructed using operational information received from the TBOAA. A TBOAA member operates an ex-Japanese purse seine vessel purchased second-hand from Japan. For the purposes of the model operational data on costs from Australian experience are combined with estimated cost of a new vessel to give a more complete appraisal of the long-term economic viability of this form of purse seining.

The Australian figures (1989) for an Australian company operating a new Japanese-style purse seine vessel of 500 t are shown in Table 2. The different inputs and assumptions for a new 300-t vessel are given in Table 3.

The spreadsheet model differs from that of FFA in the following points. Fishing is with Fish

[1] The model was developed using Lotus 123 on a Hewlett-Packard 150 Personal Computer. The present author reconstructed the model from the paper FFA 85/27 on an Apple Macintosh personal computer using a business spreadsheet (Microsoft Excel). A basic understanding of this model is assumed. The constructional details are fully explained by Anon (1985a).

Table 1. Operational details and data of a typical American 1200-t vessel with helicopter constructed in a spreadsheet format (after Anon 1985a).

Vessel operating statement			
Days fishing	249		
Days steaming	18		
Days wait and provision	8		
Days unloading	50		
Days other (r&m)	40		
Days total	365		
Projected daily catch (t)	20	days for ops	
Trips per year	4.14	325	
Projected annual catch (t)	4972	duration	
Input parameters		78.44	
Vessel fish hold capacity	1200		
Vessel cost $	9000000		
Vessel salvage value $	1000000		
Helicopter operations $/year	50000		
Port to fishing ground (n.m)	800		
Days steaming/year for refit	0		
Days waiting to unload provision	2		
Days bad weather per year	40		
Fish unloading capacity (t/day)	100		
Vessel economic life	10		
Crew number	20		
Crew share (% of gross receipts)	0		
Crew share ($/mt fish landed)	140		
Repairs and maintenance (% vessel cost)	5%		
Fuel price ($/kilolitre)	220		
Lube cost (% total fuel costs)	10%		
Galley provisions ($/person day)	8		
Fishing gear maintenance ($/year)	30000		
Management ($/year)	50000		
Vessel spares (% of vessel cost)	3%		
Fishing spares (% of gear maintenance)	80%		
Repair and main annual increment	5%		
Salt ($/t)	80		
Loan capital ($)	9000000		
NPV discount rate	10		
Loan capital cost (%)	5%		
Insurance (%book value)	2%		
Fuel use main engines (kilolitre/day)			
Steaming	8		
Fishing	4		
Idle	0		
Fuel use aux engine (kilolitre/day)			
Steaming	2		
Fishing	3.4		
Idle	1.2		
Salt usage/mt catch (kg)	90		
Debtors	200000		
Creditors	80000		
FAD operating costs	5000		
Transit speed (knots)	15		
Equity capital cost (%)	14%		

Vessel revenue statement	Year 1
Projected annual catch	4972
Fish value ($/mt)	650
Gross fish receipts ($)	3231586
Vessel operating costs	
Variable costs	
Fuel	483635
Lube	48363
Salt	35796
Crewshare	696034
Galley/provisions	42720
Helicopter operations	50000
FAD operating costs	5000
Sub total	1361548
Variable catch costs	274
Fixed costs	
Repairs/maintenance	450000
Insurance	180000
Admin management & licences	50000
Sub total	680000
Total operating costs	2041548
Total catching costs	411
Operating profit (loss)	1190039
Debt redemption cost	1165541
Net profit (loss)	24498
Vessel cash flow statement	
Capital costs	
Vessel costs	9000000
Salvage value	
Working capital	
Stocks	
Vessel spares	225000
Fishing gear	24000
Debtors	
Creditors	
Total capital costs	9249000
Operating costs	2041548
Revenue	3231586
Net operating revenue	1190039
Net cash flow	−8058961
Investment analysis	
Net present value 10%	**−1207821**
Internal rate of return %	**6.44**
Return on investment %	**13.2**
Payback period in years	**7.56**

Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
4972	4972	4972	4972	4972	4972	4972	4972	4972
650	650	650	650	650	650	650	650	650
3231586	3231586	3231586	3231586	3231586	3231586	3231586	3231586	3231586
483635	483635	483635	483635	483635	483635	483635	483635	483635
48363	48363	48363	48363	48363	48363	48363	48363	48363
35796	35796	35796	35796	35796	35796	35796	35796	35796
696034	696034	696034	696034	696034	696034	696034	696034	696034
42720	42720	42720	42720	42720	42720	42720	42720	42720
50000	50000	50000	50000	50000	50000	50000	50000	50000
5000	5000	5000	5000	5000	5000	5000	5000	5000
1361548	1361548	1361548	1361548	1361548	1361548	1361548	1361548	1361548
274	274	274	274	274	274	274	274	274
472500	495000	517500	540000	562500	585000	607500	630000	652500
164000	148000	132000	116000	100000	84000	68000	52000	36000
50000	50000	50000	50000	50000	50000	50000	50000	50000
686500	693000	699500	706000	712500	719000	725500	732000	738500
2048048	2054548	2061048	2067548	2074048	2080548	2087048	2093548	2100048
412	413	415	416	417	418	420	421	422
1183539	1177039	1170539	1164039	1157539	1151039	1144539	1138039	1131539
1165541	1165541	1165541	1165541	1165541	1165541	1165541	1165541	1165541
17998	11498	4998	−1502	−8002	−14502	−21002	−27502	−34002
								−1000000
225000								−200000
								80000
200000								
−80000								
345000	0	0	0	0	0	0	0	−1120000
2048048	2054548	2061048	2067548	2074048	2080548	2087048	2093548	2100048
3231586	3231586	3231586	3231586	3231586	3231586	3231586	3231586	3231586
1183539	1177039	1170539	1164039	1157539	1151039	1144539	1138039	1131539
838539	1177039	1170539	1164039	1157539	1151039	1144539	1138039	2251539

Table 2. The Australian figures (Australian Dollars 1989) for an ex-DWFN vessel of 500 t (data source TBOAA).

Vessel operating statement				**Vessel revenue statement**	Year 1	Year 2	Year 3
Days fishing	220			Projected annual catch	5458	5458	5458
Days steaming	48			Fish value ($ t)	1119	1197	1281
Days wait and provision	21			Gross fish receipts ($)	6105322	6532695	6989984
Days unloading	36			**Vessel operating costs**			
Days other (r&m)	40			**Variable costs**			
Days total	365			Transshipment charges	921059	985533	1054520
Projected daily catch (t)	24.78	days for ops		Fuel	467610	500343	535367
Trips per year	10.92	327		Lube	42085	45031	48183
Projected annual catch (t)	5458	duration		Salt	54035	57818	61865
Input parameters		29.96		Crewshare	1552440	1661110	1777388
Vessel fish hold capacity (tonnes)	500			Galley/provisions	58500	62595	66977
Vessel cost $	12000000			Harbour fees & wharfage	20000	21400	22898
Vessel salvage value $ 1988 estimate	750000			FAD operating costs	100000	107000	114490
Depreciation/year	1350000			Sub total	3215729	3440830	3681688
Distance to fishing grounds (n/m)	800			Operating profit	2889594	3091865	3308296
Days steaming/year for refit	0			**Fixed costs**			
Days waiting to unload provision	2			Crew repatriation	60000	64200	68694
Days bad weather per year	40			Repairs/maintenance	360000	396756	437265
Fish unloading capacity (t/day)	150			Insurance	360000	385200	412164
Vessel economic life	15			Admin management	80000	85800	91592
Crew number	20			**Access costs**	0	0	0
Crew share (wages on 3000t)	1140000			Depreciation	1350000	1350000	1350000
Crew share (bonus/t 3000t) as % price	15%			Total fixed costs	2210000	2281756	2359715
Fuel price ($/kilolitre)	220			Total operating profit before tax	679594	810109	948581
Lube cost (% total fuel costs)	9.00%			Tax	265042	315943	369947
Galley provisions ($/person day)	9			After tax operating profit	414552	494167	578635
Transshipment fees/t	169			Add back depreciation	1350000	1350000	1350000
FAD operating costs	100000			After tax profit + deprec.	1764552	1844167	1928635
Repairs and maintenance (% vessel cost)	3%			Cash flow analysis			
Repair and main annual increment	3%			Capital costs time zero	Year:	2	3
Salt ($/t)	110			Vessel costs −12000000			
Salt usage/mt catch (kg)	90			Salvage value			
Insurance (% vessel capital value)	3%				0		
Loan capital ($)	6000000			Total capital costs −12000000	0		
Weighted average cost of capital WACC	15.91%			After tax prof + deprec.	1764552	1844167	1928635
Loan capital cost (%)	13.80%			Cash flows −12000000	1764552	1844167	1928635
Fuel use main engines (kilolitre/day)							
Steaming/fishing average	6.5			NVP using WACC	0		
Vessel speed in knots	15			IRR	0.1591		

Aggregating Devices (FADs), some daylight sets, and transshipping to reefer vessels for transport to Southeast Asian markets. FAD and transshipment costs are included which reduce travelling to 800 miles per trip. Access costs can be added, but are left out in the base case. Days fished are derived from operations as per FFA. Fuel consumption is averaged on a daily basis. Price is an average tuna price (see Appendix 1). Crew remuneration is based on contract pay for first 3000 t/annum with a bonus as a percentage of revenue received for each tonne exceeding 3000 t/annum. Expenses added in this model are: repatriation of foreign crew member, harbour and wharfage fees, administration and management. Life of the project is 15 years with inflation being applied to future cash flows. Depreciation is weighted between 9% for vessel and 24% for gear and is on a prime cost basis as per Australian tax law. In the cash flow analysis operating profits are taxed at 39%. Capital borrowed is assumed to be 50% of vessel cost, the rest being provided by equity sources. Net Present Value is obtained by discounting after tax cash flows by a Weighted Average Cost of Capital (WACC) where:

$WACC = Rd \times (1-CTR) \times (D/(D+E)) + Re \times (E/(D+E))$

Define $Re = Rf + (Rm - Rf) \times ß$

Re = Return on Equity

$Rm - Rf$ = The Market risk premium (8%)

Rm = Market return

Rd = Interest on debt capital

Rf = Risk free investment...Australian long-term government bond rate.

ß (*Beta*) = Industry risk factor for international tuna fishing (assumed to be 1.2).

D = Debt capital

E = Equity capital

CTR = Corporate tax rate (Brearly and Myres 1987)

Results Using the Adapted Model

Sensitivity Analysis

Revenues are sensitive to variations in catch rate and price. Figure 2b shows combinations of catch

Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Inflation
5458	5458	5458	5458	5458	5458	5458	5458	5458	5458	5458	5458	
1370	1466	1569	1679	1796	1922	2056	2200	2354	2519	2696	2884	0.07
7479283	8002832	8563031	9162443	9803814	10490081	1.1E+07	1.2E+07	12850800	1.4E+07	1.5E+07	1.6E+07	
1128336	1207320	1291832	1382261	1479019	1582550	1693329	1811862	1938692	2074401	2219609	2374981	0.07
572842	612941	655847	701757	750879	803441	859682	919860	984250	1053147	1126868	1205748	0.07
51556	55165	59026	63158	67579	72310	77371	82787	88582	94783	101418	108517	
66196	70829	75788	81093	86769	92843	99342	106296	113737	121698	130217	139332	0.07
1901805	2034932	2177377	2329793	2492879	2667380	2854097	3053884	3267656	3496391	3741139	4003019	0.07
71665	76682	82049	87793	93938	100514	107550	115078	123134	131753	140976	150844	0.07
24501	26216	28051	30015	32116	34364	36769	39343	42097	45044	48197	51571	0.07
122504	131080	140255	150073	160578	171819	183846	196715	210485	225219	240985	257853	0.07
3939406	4215164	4510226	4825942	5163757	5525220	5911986	6325825	6768633	7242437	7749407	8291866	
3539877	3787668	4052805	4336501	4640056	4964860	5312400	5684269	6082167	6507919	6963473	7450916	
73503	78648	84153	90044	96347	103091	110308	118029	126291	135131	144591	154712	0.07
481910	531112	585339	645102	710967	783557	863558	951727	1048899	1155991	1274018	1404095	0.1021
441015	471887	504919	540263	578081	618547	861845	708174	757747	810789	867544	928272	0.07
98003	104864	112204	120058	128463	137455	147077	157372	168388	180175	192788	206283	0.07
0	0	0	0	0	0	0	0	0	0	0	0	0.07
1350000	1350000	1350000	1350000	1350000	1200000							
2444431	2536510	2636615	2745467	2863858	2842650	1782788	1935303	2101325	2282087	2478940	2693362	
1095446	1251158	1416190	1591034	1776198	2122210	3529613	3748968	3980843	4225832	4484533	4757554	
427224	487951	552314	620503	692717	827662	1376549	1462097	1552529	1648074	1748968	1855446	
668222	763206	863876	970531	1083481	1294548	2153064	2286869	2428314	2577758	2735565	2902108	
1350000	1350000	1350000	1350000	1350000	1200000	0	0	0	0	0	0	
2018222	2113206	2213876	2320531	2433481	2494548	2153064	2286869	2428314	2577758	2735565	2902108	
4	5	6	7	8	9	10	11	12	13	14	15	16
												2069274
												2069274
2018222	2113206	2213876	2320531	2433481	2494548	2153064	2286869	2428314	2577758	2735565	2902108	
2018222	2113206	2213876	2320531	2433481	2494548	2153064	2286869	2428314	2577758	2735565	2902108	2069274

rate per day and price per tonne of tuna consistent with zero Net Present Value, for the Australian vessels shown in Tables 2 and 3. Figure 2a shows that as catch per day rises, tonnage per year increases at a decreasing rate. This reflects a reduction in days fished when large catch rates cause more steaming and unloading time.

Operational Sensitivity

An indication of operational sensitivity will be seen by examining the effect of decreases or increases in expected downtime (assumed to be 40 days/year caused by bad weather and maintenance in the base case) on the NPV of the investment. Figure 3 shows the relationship between downtime and NPV for the 500- and 300-t vessels.

To the left of 40 days (Fig. 3) represents potential economic profits obtained by minimising downtime. To the right of 40 days, where NPV is negative, the effect of operational delays is seen. Delays may be related to bad weather, poor skipper and engineer skill, management and unloading to reefer vessels. The slope of the line indicates how critical will be the investment delays longer than expected through the life of the project. Delays are seen to be more critical for the 500-t vessel, a reflection of higher capital costs.

Implications of the Model

Profitability

Further examination of Fig. 2 with current catch rate and price data should be able to indicate the present state of the Australian venture. Australian operators have not completed one year's fishing and so an average catch rate per day is unobtainable. Using past data from SPC (1988) for Japanese purse seining will include group seiners and will not include 'high seas' catches. Doulman (1987c) quotes catch rates of 30–35 t/day for a 500-t Japanese vessel. Combining this with recent price data (Appendix 1) gives points A and B in Fig. 2b. This is in the area of positive NPVs, or economic profit. The curves do not include access fees payments. If

Table 3. The different inputs and assumptions for a new 300 t vessel (source interviews with fishermen).

Input parameters		
Vessel fish hold capacity (tonnes)		300
Vessel cost $		7,000,000
Vessel salvage value $ 1988 Estim		300,000
Depreciation/year		787,500
Distance to fishing grounds (n.m)		800
Days steaming/year for refit		0
Days waiting to unload provision		2
Days bad weather per year		40
Fish unloading capacity (t/day)		90
Vessel economic life		15
Crew number		15
Crew share (wages on 2500t)	890,000	
Crew share (bonus/mt >2500t) as%		15%
Fuel price ($/kilolitre)		220
Lube cost (% total fuel costs)	9.0%	
Galley provisions ($/person day)		9
Transshipment fees per tonne		169
FAD operating costs		75,000
Repairs and maintenance (%vessel cost)	3%	
Repair and main. annual increment	3%	
Salt ($/t)		110
Salt usage/mt catch (kg)		90
Insurance (% vessel capital value)	3%	
Loan capital ($)		3,500,000
Weighted average cost of capital WAC	15.91%	
Loan capital cost (%)	13.80%	
Fuel use main engines (kilolitre/day) steaming/fishing average		3.6
Vessel speed in knots		12

they did at PNG/Solomons/FSM temporary rate, points A and B would still be in the positive NPV region.

Prior to fishing in the Pacific the TBOAA estimated that a 500-t vessel, catching 20 t/fishing day, given a world price of $A1044/t would make their operation 'break even' (revenues = costs). As the NPV appraisal technique discounts future cash flows, as opposed to comparing undiscounted costs and revenues, a comparison with the model is inappropriate. However, the model indicates that catch rates of 24.8 t/day at the current tuna price ($A1118) give normal returns. Alternatively, catch in excess of 5000 t/annum was estimated by TBOAA to be above normal returns. The model indicates normal returns at 5458 t/annum (see interpolated line, Fig. 2 or Table 2). Profit looks more realisable for the 300-t vessel. However, smaller vessel capacity will make catch rates lower. Doulman (1987c) quotes catch rates for smaller group seine vessels at 17–20 t/day. Similarly, Hutton (1984) quotes catch rates for a 320-t U.S. vessel at 18–20 t/day. Using this, data point C on Fig. 2b indicates positive NPVs at current prices.

Access Fees

In the model the base case is run with no access fees. When NPV = 0 is found in terms of catch rate at the current tuna price, it is then possible to input

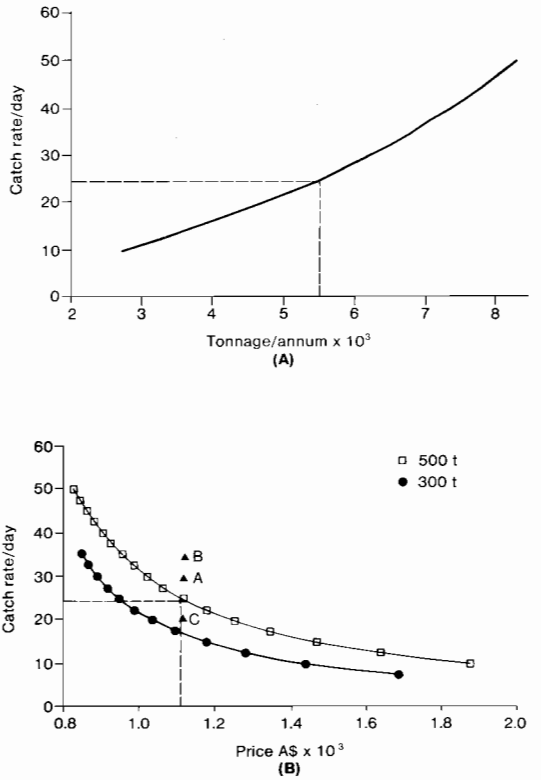


Fig. 2. (a) This reverse axis shows the catch rate versus tonnage per year aligning to the catch rate indicated in the RHS. The tonnage refers to the 500-t vessel only.

(b) The relationship between catch rate per day and price per tonne of tuna for the 500-t and 300-t Australian vessels (Tables 2 and 3 respectively). The line joins points where Net Present Value equals to zero i.e. normal returns.

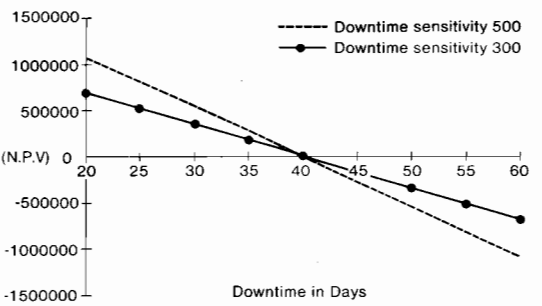


Fig. 3. The relationship between downtime and NPV for the 500-t and 300-t vessels. Forty days is the expected downtime (NPV = 0).

a higher catch rate and enter an access cost until NPV will again equal zero. Thus access cost is the total cost of access in one year. Dividing access cost by tonnage associated with catch rates, shown in Fig. 2a, would give an access fee per tonne for a given catch rate. This procedure was applied to both 500-t and 300-t vessels with catch rates being plotted against access fees in Fig. 4.

The area under the graph is a measure of the potential of a vessel to pay access fees to gain catch rates over 28.4 t/day. The line will move to the left given tuna price rises (right, if price falls) and so the capacity to pay access fees is enhanced (diminished) accordingly. The 300-t vessel is able to pay fees at lower catch rates.

Catch Rates

Tuna catches may be taken outside EEZs where catch rates may be low, but Fig. 4 shows the potential value of high density stocks within EEZs, and that the individual operator can pay some part of the area under the access curve if he can be guaranteed high catch rates within zones. From a management point of view interaction of vessels on stocks and any factors that lead to erosion of catch rates are worthy of research attention.

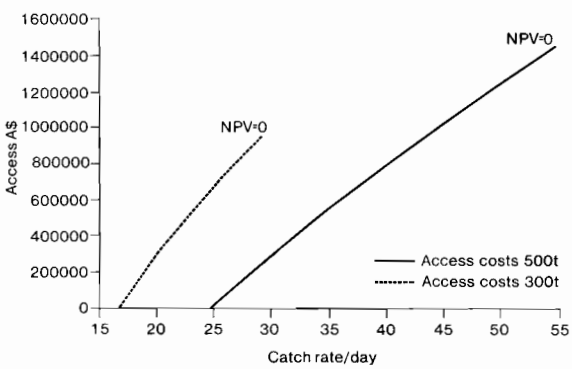


Fig. 4. Access fees against catch rates for the 300- and 500-t vessels. The lines indicate where NPV = 0 i.e. normal profit.

Australian Operators

Australian operators will be profitable given our previous assumptions. Debt repayment will be a major expense. For U.S. vessels, in year 1985, debt cost was 27.8% of total costs (Skapin and Pintz 1987). Given fluctuations in the world tuna price, as seen several years ago, the extent of leverage, represented implicitly by the WACC (debt and equity were estimated by the author and not confirmed by the TBOAA as the information is confidential and differs for each member), will be critical. Future Australianisation of fishing will involve a learning period with mistakes leading to downtime. Bridging cash flows, due to the decline of the SBT, may make the learning period difficult.

Australians and Comparative Advantage

Average cost of tuna production is a measure of productive comparative advantage. In the present study, TBOAA data were inadequate to compare average costs of production for different vessel sizes. A possible comparison, given the limited data, is with average cost data provided by Hutton (1984). Hutton compares operating costs for various U.S. purse seiners with the caveat that 'All of the costs are estimates and therefore should not be assumed to represent the true costs involved in actual operation.' Hutton's results were indexed for inflation and converted to Australian dollars (inflation index was the U.S. industrial index and an averaged exchange rate for the past 4 years). This then enables the figures from the Australian vessels to be compared with U.S. data in Fig. 5.

Distance of operation is critical to operational efficiency for a U.S. style operation, as shown in Fig. 5. In the 6000-mile operation there are seemingly economies of scale to be obtained by utilising larger vessels. For the opposite case, 500-mile short distances, small vessels operate at lower average cost per tonne than any of the larger vessel or distance alternatives. Smaller vessels close to the tuna resource could have a comparative advantage in producing tuna (Hutton 1984; Stanley 1986). This potentially could be the case for Solomon Islands. However, a country like Kiribati would have vessels travelling large distances.

For the two Australian vessels, travelling 800 miles, operational costs appear higher than U.S. counterparts. The data were compared for similar costs, but Australian costs like management, transshipment, wharfage, and crew repatriation were not counted. If included figures would be $766 /t as opposed to $534/t and $747/t as opposed to $501/t for the 300-t and 500-t vessels respectively.

This is reinforced by comparing catch rate versus price curves for the FFA model figures indexed and exchanged to 1988 levels. It appears from Fig. 6 that the 1200-t vessel is more viable at similar catch rates and prices than the 500-t vessel. This contradicts the case of the 300-t vessel in Fig. 2 and makes the 500-t Australian vessel appear high cost in comparison to a 1200-t U.S. vessel.

Comparing these data may be misleading. The models use different discount rates, debt equity

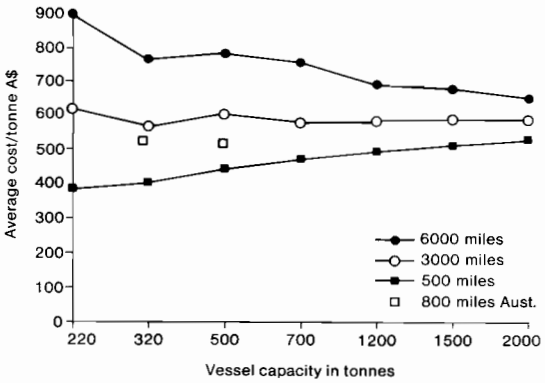


Fig. 5. Plot of average cost per tonne of tuna versus vessel size under three different operating distances (after Hutton 1984). Australian figures are for a 300- and 500-t vessel travelling 800 miles.

assumptions and project life spans. Anon (1985a) is in real terms and not inflation-adjusted. They are strictly not comparable.

Given the poor data, the conclusion most appropriate is that comparative operational advantage needs further examination from a sound cost database for the various nations fishing the Pacific.

Discussion

Australians have gained access to some of the world's best tuna resources and have been catching tuna in quantity. From examination of Anon (1988) it is apparent that the TBOAA have done some detailed investigation of the basic prerequisites for success in this venture.

The experience of lenders to the U.S. tuna fleet concur with the factors deemed critical by the Australian operators as to the fundamentals of a good tuna fishing operation (Skapin and Pintz 1987).

In the Australian case the TBOAA have past experience in tuna fishing, canning and have developed links with established markets and Japanese fishing companies with financing arrangements. Importation of proven ex-DWFN vessels and Japanese crew have secured success in the short term at present prices. Using Japanese crew is not a long-term solution, but with the Australian industry being intrinsically inshore, not experienced in distant water fishing, Australianisation may be difficult.

Future Australian Plans

It is envisaged by the TBOAA that several ex-U.S. vessels could be purchased or leased and utilised in the future. A list of 12 vessels, most less than 500 t, wishing to gain access to PNG during 1989 has been submitted to the PNG Government. This is a rapid expansion of an idea in its infancy. As the TBOAA are aware 'if we fail it will be a management problem as opposed to a resource problem' (Anon. 1988).

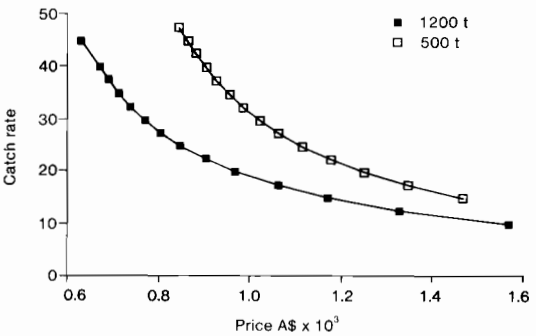


Fig. 6. Comparison of NPV curves for 500-t Australian and a 1200-t U.S. operation.

Implications for the Region

Can a small island state learn anything from the Australian experience? Given the often quoted aspiration of coastal states in the Western Pacific to exploit their tuna resources, there are some similar and contrasting points between the Australian venture and the problems of developing tuna fishing in a small island state.

- -Teething problems occurred for Australian operators who have had many years of fishing experience. It is reasonable to suppose the learning curve will be steeper, as may the downtime curve, for an island state acquiring industrial tuna fishing capacity. A report on purse seine potential in Kiribati (Anon. 1985b) confirms this: 'Kiribati lacks any experience in this highly complex industry. The country would have a large and long learning experience in front of it...Abrogating the responsibility for managing the vessel to an experienced management company would be a way of easing Kiribati into the industry.'
- -Australians face potential crew shortages at all levels, whereas small island states often have shortages of more highly qualified, experienced masters. The solution to these problems seems as yet unresolved.
- -Australians' previous fishing experience did not significantly help in the Pacific. Similarly small islands start from low industrial fishing experience.

-Australians through past commercial contact with the Japanese may have access to capital at competitive rates. Generally small island states do not.

-Australians operate away from home using transshipment. Small island states often have tuna stocks close to home base. Is this a major asset?

-Management is the key identified by the Australians to success or failure, given sound financial prerequisites. Management has been identified as a weak area for small island state ventures. This is an important difference. Management teams on a contract basis are crucial to future tuna industry development in the Pacific (Anon. 1985b). How Australians overcome the operational difficulties of entering Pacific tuna fishing, previously outlined, may give small island states insight to the problems they will face.

Should the TBOAA venture be successful this could lead to benefits in the region. Given the need for a cannery (Doulman 1987b) and onshore tuna infrastructural developments in PNG, it may be that Australian involvement in Pacific fishing could prompt the support of such ventures through the Australian aid program. Such possibilities are as yet unclear.

Conclusions

Access to the Pacific has been negotiated by the Australian Tuna Boat Owners' Association. Individual operators are concerned with financial profitability of the venture which returns above normal profits at present projected catch rates. The Australians believe they have two major qualities to bring to the fisheries of the Pacific.

(1) A good record in terms of entrepreneurial ability in fishing and canneries.

(2) A fresh image, compared to other DWFN nations in the region.

These are reasonable points, but a clear comparative advantage in producing tuna at lower cost per tonne than other nations is not evident. So will the Australian venture be successful? Given sound financial prerequisites, this will depend on how quickly the learning curve is climbed and whether mistakes are recognised and rectified. The TBOAA are aware of their potential and limitations. Provided economic fundamentals continue, the venture can succeed. Short-term cash flow problems may occur depending on the individual company's liquidity position, particularly in the early years. Crewing arrangements for the future remain unresolved. Long-term viability may be elusive if good prices do not continue. If Australians do not succeed, then it may just prove the already well-known adage that 'tuna fishing is a risky business.'

Research Areas Identified

Research should be conducted into the following areas:

(1) Purse seining cost data for various sized vessels and nationalities fishing tuna in the Western Pacific;

(2) Tuna markets, their price fluctuations, biological and technical interactive factors influencing tuna catch rates;

(3) Bioeconomic analysis for policy formulation in rent retrieval by coastal states, utilising financial models, sound cost data and biological information; and

(4) The development of fishing vessel operation analysis so as to be more accurate in financial modelling of tuna fishing.

Acknowledgments

I wish to thank the following people and organisations for their help in gaining information for this paper: Mr Brian Jeffries, Executive Officer, the Tuna Boat Owners' Association of Australia (TBOAA); Mr David Puglisi, Management Executive, Bluefin Exporters Pty, Port Lincoln, South Australia; Mr Peter Phillipson, Senior Economist, the South Pacific Forum Fisheries Agency; Mr B. Scott and staff members, the tuna section of the Australian Fisheries Service, Canberra; and Mr Bob Gillett, UNDP support program, Suva, Fiji. I wish to acknowledge the helpful comments of Professor Harry Campbell, Economics Department, University of Tasmania.

References

Anon. 1985a. The Purse Seine financial appraisal model. South Pacific Forum Fisheries Agency, Honiara, Solomon Islands. FFA report No. 85/27.

1985b. Kiribati team report. (Under New Zealand aid). Chapter six.

1988. Access by Tuna Boat Owners Association of South Australia boats to PNG. Discussion paper by TBOAA. Unpublished confidential document.

Barwell, L. 1980. *Frontier* completes first phase of skipjack feasibility project. Australian Fisheries, February.

Beddington, J. 1985. Requirements for bio-economic analysis for maximising benefits from the management and development of tuna resources. In: High level meeting on regional co-operation in fisheries management and development, Honiara, Solomon Islands 26–29 March 1985. HLM/9.

Brearly, R., and Myres, S. 1987. Principles of Corporate Finance. McGraw Hill.

Cribb, J. 1988. Fishing for trouble. The Weekend Australian, September 24-25.

Doulman, D.J. 1987a. Licensing distant water tuna fleets in Papua New Guinea, Marine Policy, January, 16-28.

1987b. Prospects and directions in the tuna fishery. Tuna issues and perspectives in the Pacific Islands region. (Doulman, D.J. ed.). East-West Center, Honolulu, 299-312.

1987c. Purse seine fishery. Tuna issues and perspectives in the Pacific Islands region. (Doulman D.J. ed.). East-West Center, Honolulu, 143.

Geen, G., and Nayar, M. 1988. Individual transferable quotas in the southern bluefin tuna fishery: An economic appraisal. Workshop on the scientific foundations for rights based fishing, Reykjavik, Iceland, 27 June-1 July 1988.

Gillett, R. 1986. Observations on two Japanese purse seining operations in the equatorial Pacific. Tuna and Billfish Assessment Programme Technical Report No. 16 South Pacific Commission.

Hampton, J., and Majkowski, J. 1986. Scientists fear SBT problems worsening. Australian Fisheries. December.

Hutton, G. 1984. Tuna purse seining technology in the West Pacific. Forum Fisheries Agency Workshop on National Tuna Fishing Operations, Tarawa, Kiribati. May 28-June 2.

Kearney, R.E., and Gillett, R.D. 1979. Interim report of the activities of the skipjack survey and assessment programme in the waters of Australia. SPC Preliminary Country Report No. 17.

Kida, H., and Phillipson, P. 1988. Financial projections: Proposed Kiribati Sashimi Longliner. South Pacific Forum Fisheries Agency, Honiara, Solomon Islands. FFA Report No. 88/3.

Reilly, L. 1989. New boat import policy could help Port Lincoln. Professional Fisherman, February.

Skapin, B., and Pintz, W.S. 1987. Financing a tuna project. In: Doulman, D.J. (ed.). The development of the tuna industry in the Pacific Islands region: An analysis of options. East-West Center, Honolulu, 303-324.

SPC. 1988. Regional Tuna Bulletin. Second quarter 1988. Tuna and Billfish Assessment Programme, South Pacific Commission, Noumea, New Caledonia.

Stehr, H. 1984. Ideas on the high technology methods needed for the catching of tuna in the Western Pacific. Australian Maritime College — The Australian fishing industry — today and tommorrow. 10-12 July 1984.

Stanley, J. 1986. Options for the Pacific Island countries in the development and management of their tuna resources. Presented at the University of Washington, Institute for Marine Studies World Fisheries Project Tuna Workshop, University of British Columbia, Vancouver, 3 July, 9.

Te Mautari. 1985. Alternative fishing methods — purse seining. Corporate plan, 1985-1989, Te Mautari Fishing Company Ltd, Kiribati. Chapter 6.

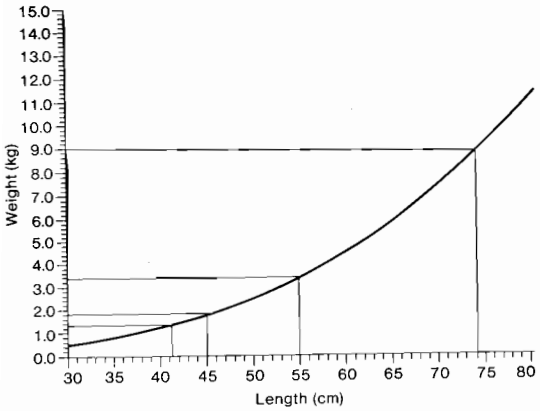
Williams, K. 1984. Australian skipjack surveys inconclusive. Australian Fisheries, February.

Appendix 1. Estimating an Average Tuna Price

Vessels catch different species and sizes of tuna, the market paying according to species and weight. Current market price data were obtained from the TBOAA for various sizes of skipjack and yellowfin. Table 1A below records the data and the averaging technique. The species ratio is taken from SPC (1988). An estimate of occurrence

Table 1A. Calculation of the average tuna price.

YELLOWFIN					
Form and Grading	Price US$/m	Size as % of Catch ***			
< 3 lb/pc	600	11%		180.1	108071
3-4 lb/pc	800	4%		65.5	52398
4-7.5 lb/pc	1050	11%		180.1	189124
7.5-20 lb/pc	1100	49%		802.3	882579
over 20 lb/pc	1200	25%		409.4	491231
		100%		1637.4	
SKIPJACK					
Form and Grading	Price US$/m	Size as % of Catch ***			
< 3 lb/pc	600	12%		458.5	275090
3-4 lb/pc	760	17%		630.4	479114
4-7.5 lb/pc	860	47%		1776.6	1527893
7.5-20 lb/pc	920	25%		955.2	878758
		100%		3820.7	
Total Catch	5458		Total Value		4884258
Ratio Skipjack: Yellowfin		70%		30%	
		Average 'Tuna Price' in US $=			894.86
		$A =			1118.58



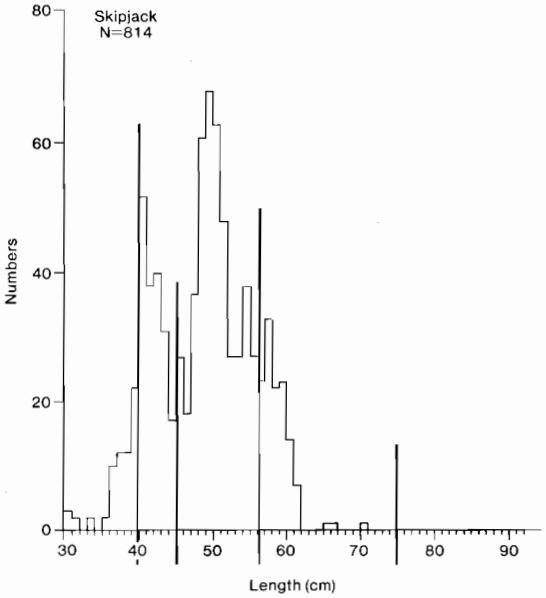


Fig. 1A. (a) Length vs weight relationship for skipjack tuna and (b) length vs numbers of fish for skipjack tuna (after Gillett 1986). Construction lines equate to market size bandings.

of numbers in each market category was obtained from Gillett (1986) for a Japanese single purse seine vessel similar to the Australian vessel considered. Tuna market weight limits were applied to the Weight vs Length relationship for each species revealing a fish length. This in turn was applied to a plot of Numbers of fish vs Length. The number of fish in each size band were counted and expressed as a percentage of the total sample size. This enabled the average tuna price to be calculated and converted to Australian dollars.

Research and Development Strategy

A Framework for Priority-Setting for Fisheries Research

R.K. Lindner[1]

Abstract

In the first part of this paper, fisheries research is treated as an investment undertaken by society in the hope of generating future benefits. This perspective on research is used to identify those variables which ought, in theory, to be incorporated into assessment of research priorities. These key variables are the ratio of potential gross annual research benefits (GARB) to average annual research costs (ARC), the estimated probability that potential GARB will in fact be realised, the expected duration of the research project, the anticipated time lag from completion of the research to realisation of the benefits, and the expected duration of realisation of these benefits. A simplified formula is used to suggest which of these variables are likely to be of greater or lesser importance in determining net returns to research. The 'social surplus' approach to quantitatively estimating GARB is then described, and the relative importance of its various determinants for fisheries research are discussed. Particular attention is paid to the interaction between management of the fishery and the size of GARB.

Introduction

THE term 'framework' is included in the title for this paper because my aim in writing it was to provide those engaged in fisheries research with a better understanding of the principles of research priority-setting as applied to fisheries research. There are two reasons for doing so rather than attempting to produce a recipe which could be employed in a mechanistic manner to proscribe which research projects should or should not be undertaken.

Over the years, a number of sophisticated systems for determining research priorities have been developed (e.g. see Fishel 1971), but failed to gain acceptance by research managers as an operationally useful aid to their decision-making procedures. No doubt there are a variety of reasons for such failures, including the opportunity cost of the time input required of both scientists at the workbench and of research managers. Given this track record, there seemed to be little point in a further attempt to produce a 'cookbook' approach to research priority setting.

Second, at the level of decisions about which research projects should or should not be undertaken, there are strong grounds for leaving such choices to the research officers who will actually carry out the research. Part of the basis for this position, to be explained in more detail later in this paper, is the sensitivity of research priorities to the probability that the objectives of the project will be achieved. The other part of the argument is the conclusion reached by Koestler (1964) in his detailed study of the psychological basis of the process of scientific discovery that the 'human factor' is the key to successful scientific research. If this view is correct, then a necessary condition for improved

[1] School of Agriculture, The University of Western Australia, Nedlands, Western Australia 6009.

research priority-setting is better understanding by individual scientists of the determinants of returns to research.

The scope of this paper is restricted to those matters dealt with in the literature on research management which are likely to be helpful to scientists and managers of fisheries research in making priority-setting operational. Specifically, no attempt is made to review that part of the literature in which the rationale for setting research priorities is discussed at considerable length. Instead, it is simply assumed that the need to establish priorities is self-evident when research is conducted by publicly accountable organisations. Futhermore, it also is assumed that the objective of publicly funded research is to maximise the rate of return to that society which provides, either directly or indirectly, the funds for the research. It can be, and has been, argued that such research should have other objectives in addition to, or instead of, the objective of maximising efficiency of resource use. To the extent that the aim of fisheries research is to achieve other objectives, such as minimising unemployment and/or correcting a balance of trade deficit, and/or reducing inequities in the distribution of income, the analytical framework outlined in this paper will not be appropriate.

Fisheries research, like other types of research, is characterised both by considerable uncertainty about the outcome of individual projects, and by very lengthy time lags between initiation of a research project and realisation of any potential benefits. Consequently, the framework for assessing research priorities must explicitly address the inherent uncertainty about realisation of potential benefits as well as the problem of comparing cost and benefits incurred and received at different points in time. To a greater or lesser extent, most forms of investment share these characteristics, so the approach advocated in this paper is to apply the techniques of cost-benefit analysis (see also Contant and Bottomley 1988, Davis et al. 1987, Norton and Pardey 1987, and Wise 1975), modified where necessary, to the task of evaluating alternative forms of fisheries research. In other words, such research is viewed as an investment in the generation of knowledge about the fishery which might generate benefits from improved efficiency in the utilisation of fish stock(s) by society. (The return to investment in agricultural research has been estimated in a number of studies, and consistently found to be high — see Evenson et al. 1979 for a review.)

Whether such a framework is suitable for assessing research priorities for 'curiosity-oriented' research is a matter for debate which will not be entered into in this paper. Instead, I will restrict my comments to what might be termed 'mission-oriented' research in the sense that the specific objective of an individual research project is to generate information and/or an innovation which *might* improve the efficiency of resource allocation.

Note that while this definition could be interpreted to include what is sometimes termed basic research, it will not be so used in this paper. In theory, the analytical framework to be outlined below could be applied to all research. However, there are substantial, possibly insurmountable, practical difficulties in applying the approach proposed below to research which has as its objective the acquisition of 'basic' knowledge rather than the generation of an innovation which can be applied directly upon successful completion of the research project. Therefore, the scope of this paper also is restricted to what might be termed 'applied' research.

Fisheries Research as an Investment

Like other forms of investment, incurring the costs of mission-oriented research can be justified as a necessary precursor to the discovery of new knowledge that might generate future benefits. Unlike other forms of investment, research is by definition characterised by pervasive uncertainty. There is uncertainty about the period of time needed to complete any given project, and there is uncertainty about the cost of doing so but, above all else, there is uncertainty about whether a successful outcome will be achieved or not.

The outcome of any given research project will fall into one or more of the following three broad classes:

- ☐ FAILURE in the sense that nothing new is discovered during the course of the project. (Such an outcome is comparatively rare, and still has value insofar as it demonstrates the futility of particular line(s) of investigation.)
- ☐ PARTIAL SUCCESS in the sense that new knowledge is discovered which, while it cannot be used immediately to generate tangible benefits, might prove useful as an input to further research.
- ☐ TOTAL SUCCESS in the sense that new knowledge is discovered which has the potential to be used immediately to generate tangible benefits.

There is little doubt that partially successful outcomes as defined above are common to a large proportion of individual research projects. Moreover, while multiple outcomes within each of these categories are possible and even likely, it will be heuristically convenient to assume that there are only two possible outcomes, failure or total success. The advantage of this approach is that uncertainty about the outcome can be represented by a single parameter to be termed the probability of success.

The outcome of a successful research project so defined might take the form of a process innovation (e.g. a more efficient method of catching fish), a product innovation (e.g. a more desirable fish product), or improvement in knowledge about the fishery (e.g. a more accurate assessment of the size of a fish stock) which has the potential to be directly employed to generate positive benefits to the party or parties adopting the results of the research project. Whatever the exact form of the potential benefits from the research project, *ex ante* evaluation of such potential benefits in relation to research costs needs to take account of the uncertainty inherent in the research process as well as the separation of timing of costs and potential benefits.

If an individual research project does not succeed in producing an innovation or information which can be applied to the benefit of society, then the time profile of costs and benefits for such a scenario is depicted in Fig. 1. On the other hand, if the project is successful, then the initial period of negative benefits (i.e. costs) will be offset at some point of time in the future by a period of positive benefits as the results of the successful research project are put into practice. An example of the *ex post* profile of costs and benefits of a project that proves to be successful is depicted in Fig. 2.

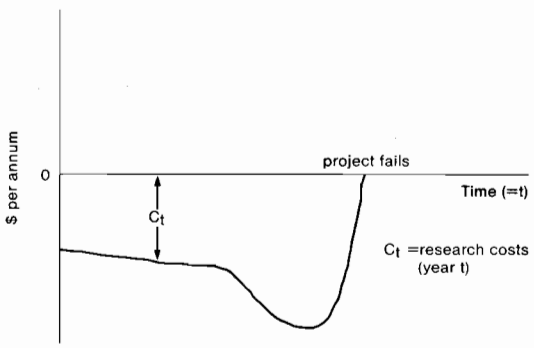


Fig. 1. Scenario 1: Research project fails (i.e. produces no innovation).

In the theory of investment appraisal, the criterion for an affirmative decision to invest in a project is that the net present value (*NPV*) of the project be greater than zero. For a research project characterised by uncertainty about the dichotomy of outcomes, this criterion needs to be modified to one requiring the *expected* present value of benefits to exceed the present value of costs (i.e. that expected net present value, $E(NPV), >0$).

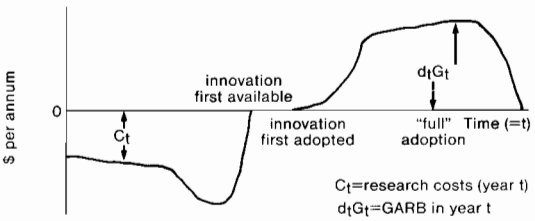


Fig. 2. Scenario 2: Research project 'succeeds' (i.e. produces an innovation).

The actual formula to calculate expected net present value using this simplified approach is:

$$E(NPV) = \sum_{t=1}^{\infty} [-C_t + p_t d_t G_t] (1 + i)^{-t} \quad (1)$$

where C_t = Cost of research in year t
G_t = potential gross annual research benefits (GARB) in year t
p_t = probability that research output is available by year t
d_t = proportion of maximum potential level of adoption of research output achieved in year t conditional on output being available by year t.

The potential level of benefits will not be realised in all years for a variety of reasons. It is by no means uncommon for there to be a delay of several years between successful completion of a research project and discovery of the results by potential adopters. Moreover, even after discovery of the existence of the innovation, most potential adopters further delay using it even on an experimental basis, often for a period running into years. The purpose of this further delay is to evaluate whether it is in their best interests or not to adopt the innovation or information. Consequently, in most cases the innovation can be expected to diffuse only slowly throughout the population of potential adopters, resulting in the classic S-shaped diffusion curve. Once the innovation is fully adopted, the potential level of GARB will depend, *inter alia*, on how widespread is this level of adoption. Other

determinants of the level of GARB have been discussed by Lindner and Jarrett (1978), and also will be discussed further in this paper.

While the level of annual research costs (ARC) and the realised level of gross annual research benefits (GARB) are both likely to fluctuate over time, the analytical framework can be drastically simplified by ignoring such fluctuations. Specifically, it will be assumed that ARC is constant for the duration of the research project, and zero thereafter; and that realised GARB from a successful research project also does not vary during a defined benefit realisation period, and is zero outside of that period. For a hypothetical successful research project, the difference between actual research expenditure and benefits on the one hand, and assumed research expenditure and benefits on the other, can be seen by comparing the net benefit profiles illustrated in Fig. 2 and 3. It is argued that any errors arising from this simplification process are likely to be trivial compared to potential errors arising from the inherent difficulty of predicting a more completely specified model.

Given these assumptions, expression (1) above simplifies to:

$$E(NPV) = C[p.d.G.C^{-1}((1+i)^{n}-1)(1+i)^{-(h+m+n)} + (1+i)^{-h}-1]/i. \quad (2)$$

if C_t = C for years 1 to h, and zero thereafter

d_t = d for years $(h+m)$ to $(h+m+n)$
0 for other years

p_t = p for years h to $(h+m+n)$
0 for other years

G_t = G for years h to $(h+m+n)$
where G = potential GARB given total adoption.

Expressing the formula in this way permits exploration of the sensitivity of $E(NPV)$ to variation in the following variables:[2] (a) annual research costs, C; (b) the discount rate, i; (c) implementation delays, m; (d) realisation period, n; and (e) the expected ratio of realised GARB to annual research costs ($p.d.G/C$).

Note that $E(NPV)$ is perfectly linear in C. This is especially convenient as it permits average ARC to be treated as the numeraire, thereby reducing the number of variables requiring explicit discussion. By contrast, $E(NPV)$ is nonlinear in terms of research duration, h.

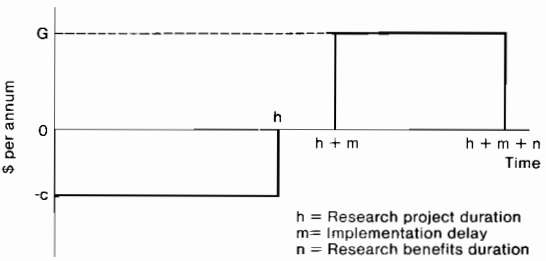


Fig. 3. Scenario simplified: Research project 'succeeds' (i.e. produces an innovation).

Of the other parameters in the equation, the implementation delay encompasses both the discovery lag while potential users of the research results become aware of their existence, and the average time lag to adoption by potential users. This implementation time lag, and the length of time over which potential research benefits are likely to be realised, are both hypothesised to differ systematically between different research areas.

Finally, there is the composite variable, $p.d.G/C$, which I will refer to as the target expected return to cost ratio. Note that this ratio is akin to an elasticity in the sense that it is dimensionless. It subsumes many of the crucial and difficult-to-measure determinants of net research benefits, such as the probability that the project will yield useful results, the likely ceiling level of adoption by potential users (that is, the so-called 'scale' effect), and the potential benefit level per unit of scale.[3]

Given estimates of the number of years needed to complete the research, the number of years' delay before implementation, and the number of years before the results become obsolete for each case, it is a simple matter to calculate the target expected return to cost ratio for $E(NPV)$ to be positive. The computed ratios for selected parameter values are presented in Table 1. In summary, the most striking feature of Table 1 is the low values (less than 2) of target expected return to cost ratios required for $E(NPV)>0$ when the more easily predicted

[2] The partial derivatives of $E(NPV)$ are attached as Appendix A. Great caution needs to be exercised in interpreting such sensitivity measures, because the *ceteris paribus* assumption almost certainly breaks down. For instance, any attempt to maximise $E(NPV)$ by substitution between annual research costs, C, and research duration, h, is likely to also induce changes in one or more of p, G, m, and n.

[3] It is not uncommon to avoid the problems inherent in estimating some of these parameters in studies evaluating research priorities for agricultural science by assuming standard values (for instance, see Edwards and Freebairn 1984). Despite the difficulty of doing so, I believe that assessments of this type will be of little value until possible variation in all of these determinants can be predicted with some degree of confidence.

Table 1. Target ratio of gross annual research benefits (GARB) per $ annual research cost (ARC) for $E(NPV) > 0$ (at discount rate = 5%).

Project duration (years)	Benefit duration (years)	Implementation delay (years)				
		1	2	4	8	16
1	1	1.10	1.16	1.28	1.55	2.29
2	2	1.16	1.22	1.34	1.63	2.41
4	4	1.28	1.34	1.48	1.80	2.65
8	8	1.55	1.63	1.80	2.18	3.23
16	16	2.29	2.41	2.65	3.23	4.76
32	32	5.00	5.25	5.79	7.04	10.40
1	4	0.30	0.31	0.34	0.42	0.62
2	8	0.33	0.35	0.39	0.47	0.69
4	16	0.42	0.44	0.48	0.59	0.87
8	32	0.63	0.67	0.73	0.89	1.32
16	64	1.30	1.36	1.50	1.83	2.70
32	128	3.96	4.16	4.59	5.57	8.23
1	16	0.10	0.10	0.11	0.14	0.20
2	32	0.14	0.14	0.16	0.19	0.28
4	64	0.24	0.25	0.27	0.33	0.49
8	128	0.50	0.53	0.58	0.71	1.04
16	256	1.24	1.30	1.44	1.75	2.58
32	512	3.95	4.15	4.58	5.56	8.22

parameters of duration of the research project, implementation delays, and likely duration of benefit realisation take on modest values.

Subjective, even qualitative estimates of the probability of success, ceiling level of adoption, potential GARB, and annual research costs can then be combined to assess whether the target expected return to cost ratio is likely to be exceeded or not.

To sum up, the variables which need to be estimated to derive an estimate of expected net present value of a research project using the advocated simplified approach are as follows:

1. Average annual research expenditure (c).
2. Duration of the research project (in years) (h).
3. Probability of a successful outcome to the research project (p).
4. Duration of the implementation delay, defined as the sum of the discovery time lag and the average duration of the adoption time lag (measured in years) (m).
5. Ceiling level of adoption of the research results (assuming successful outcome) (d).
6. Potential level of GARB (G).
7. Research benefit longevity (n).
8. Discount rate (i).

Determinants of Potential GARB

It is not possible to provide an exhaustive treatment of the determinants of GARB within the scope of this paper, and in the main what follows is a selection of some of the findings from a more comprehensive treatment of this topic in Lindner (1989). Specifically, in this paper the effect of the following three considerations on the size of sustainable GARB[4] will be illustrated:

- ☐ the method (if any) of fisheries management
- ☐ the current level of exploitation of the fish stock
- ☐ the nature of the shift in the sustainable supply or demand curves induced by adoption of technology arising from successful completion of research.

One of the most important determinants of the potential benefits from fisheries research is the type of management system practiced in those fisheries likely to take up the new technology. Because there is a wide variety of different fishery management systems practiced around the world, only two polar extremes will be considered in this paper. One is the case of an open-access fishery with absolutely no restrictions on level of fishing effort. It is well known that the sustainable supply curve for such a fishery has a positive slope at very low levels of exploitation, but subsequently is backward bending (see Copes 1970; Clark 1976; and others). At the other extreme, it will be assumed that the fishery is managed so as to maximise economic yield (rent) with zero administrative and enforcement costs. The sustainable supply curve associated with such a management regime never becomes backward bending, but does become highly inelastic, and in fact asymptotically approaches maximum sustainable yield (MSY) as degree of exploitation of the fish stock increases. Most fishery management systems in use are likely to generate sustainable supply curves that fall somewhere between these two extreme cases.

In Fig. 4 the sustainable supply curve of a fishery managed so as to maximise economic yield is depicted by the curve labelled S_m, while the

[4] The results presented in this section are based on a comparative static analysis of steady-state sustainable supply and/or demand curves under two mutually exclusive scenarios. One is that there is no research. The other is based on the assumption that the research is conducted, and that the outcome is totally successful in the sense defined above. This approach ignores the short-run consequences for GARB arising from adjustment from one steady-state (sustainable) equilibrium to another. To analyse these short-run consequences would require a different analytical framework outside the scope of this paper.

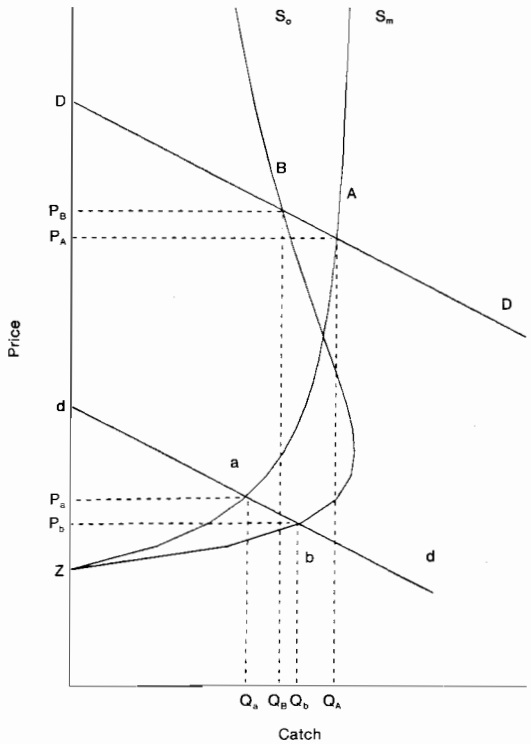


Fig. 4. Benefits from improved management.

corresponding sustainable supply curve for the same fishery in an open-access situation is represented by the curve labelled S_o. Superimposed on these two supply curves are two demand curves which depict the alternative cases of a lightly exploited fishery on the one hand, and of a heavily exploited fishery on the other.

The intersection of each supply curve with the demand curve labelled *dd* depicts the sustainable equilibrium level of price and output in a lightly exploited fishery under the two alternative management regimes. It can be seen that, as long as the demand curve is less than perfectly elastic, the sustainable market equilibrium in the managed fishery involves a smaller quantity of fish being caught, but being sold at a higher price than would be the case for an open-access fishery. The corresponding sustainable outcome for a heavily exploited fishery is represented by the intersection of the demand curve labelled *DD* with the two supply curves. This situation is the reverse of that for a lightly exploited fishery, with price being lower and quantity caught being greater in the managed fishery than would be the case were there no management.

These differences in equilibrium levels have important implications for the level of benefits derived by society from exploitation of the fisheries. It is well known that in an open-access situation, all fishery rent is completely dissipated in the long run. Consequently, the only possible benefit to society from exploiting such a fish stock will be in the form of consumer surplus generated by the opportunity to consume more fish at a lower price, provided of course that market demand is less than perfectly elastic. For the case of an open-access fishery as depicted by curve S_o in Fig. 4, the sustainable amount of consumer surplus generated if the fishery is lightly exploited (i.e. demand curve *dd*) is represented by the area of the triangle dbP_b. The corresponding area for a heavily exploited fishery is the triangle DBP_B, which as drawn is smaller than dbP_b. In general though, the relative size of these two triangles will depend on the precise position of the two demand curves.

By contrast with the case of an open-access fishery, economic rents are generated if the fishery is managed so as to maximise economic yield (MEY). The size of these rents can be depicted in our diagram by the area above the managed fishery sustainable supply curve (S_m) and the equilibrium level of price. Consumer surplus needs to be added to economic rent for such a fishery to arrive at a figure for total social benefit derived from exploiting the fishery. In Fig. 4, the level of total social benefits for the lightly exploited fishery is represented by the area *daZ*, while the corresponding area for the heavily exploited fishery is *DAZ*. Any increase in the size of the relevant area of social surplus arising from the adoption of research results provides a measure of potential GARB.

The difference in sustainable social surplus between the open-access case and that of the same fishery being managed for MEY provides an upper bound measure of potential GARB from research needed to implement an efficient system of fishery management. One example of research which might generate benefits of this type is stock assessment. Another example is economic analysis of the efficiency of alternative fishery management practices in different types of fisheries (e.g. Campbell and Lindner 1989).

If the fishery is lightly exploited, the gain in sustainable social surplus from adoption of a more efficient management scheme may well be slight. For instance, in Fig. 4 the maximum potential gain is only equal to the amount by which area *daZ*

exceeds area dbP_b. On the other hand, in a heavily exploited fishery, the potential gain from efficient management can be very substantial. This measure of potential GARB is represented by the area P_BBAZ in Fig. 4. Furthermore, such areas understate the true benefits of research necessary for more efficient fisheries management, because it will be shown below that efficiency of the management system is a key determinant of potential GARB from other types of research.

In order to explore other determinants of GARB, it is first necessary to predict how adoption of research results will affect sustainable supply and/or demand conditions. In doing so, it will be convenient to interpret diagrams of supply of, and demand for, fish as applying to the catching sector of the fishing industry. Hence the effect of successful research which results in improvements in efficiency in the processing and/or marketing of fish, as well as of marketing research which opens up new markets for fish, can be represented as an increase in demand for the products of the catching sector (see Freebairn et al. 1982).

In Fig. 5, this increase in demand is depicted by a parallel upward shift of the demand curve. (While there is no necessary reason for the shift in demand curve to be parallel, it is assumed to be so simply for expositional convenience.) For the managed fishery, the size of GARB can be measured by the area between the no-research demand curve (d_0d_0 or D_0D_0) and the with-research demand curves (d_1d_1 or D_1D_1) which is bounded on the left by the vertical axis and on the right by the supply curve for the managed fishery S_m. (To comprehend why this area measures GARB, consider the case of the lightly exploited fishery where the area depicting total social surplus in the absence of research is given by the quasi-triangular area d_0a_0Z, while the corresponding measure of social surplus for the with-research case is represented by the area d_1a_1Z. Hence the difference between these two areas is the four-sided area $d_1a_1a_0d_0$ lying between demand curve d_0d_0 and d_1d_1 and inside the supply curve S_m.) Note that the size of GARB is somewhat larger for the heavily exploited fishery ($D_1A_1A_0D_0$) than is the case for a lightly exploited fishery ($d_1a_1a_0d_0$). While not represented in Fig. 5, it also should be self-evident that the size of GARB for this type of research also will be related to the potential size of the fishery as indexed by a concept such as maximum sustainable yield.

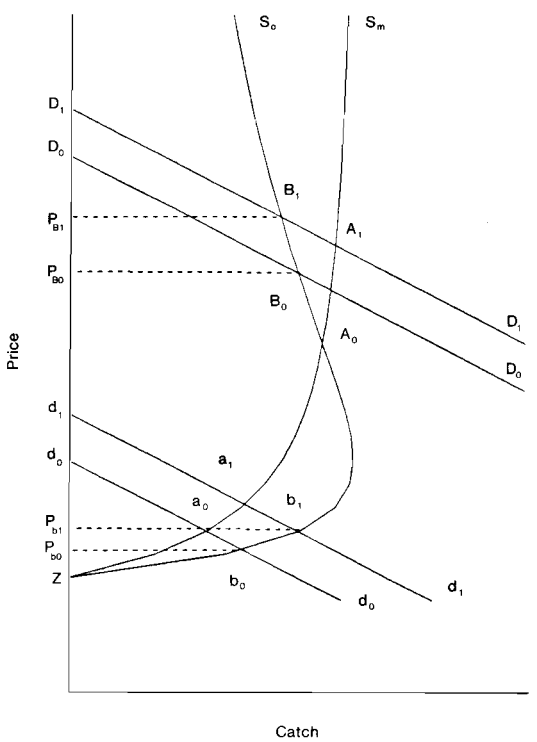


Fig. 5. Benefits from improved demand.

Measurement of potential GARB from demand increasing research in an open-access fishery is less straightforward. In Fig. 5, the size of sustainable GARB for a lightly exploited fishery is represented by the difference between the triangle $d_1b_1P_{b1}$ and the triangle $d_0b_0P_{b0}$. While not large, this difference is at least positive. By contrast, inspection of the corresponding areas for the heavily exploited case reveal that the area of sustainable surplus for no research ($D_0B_0P_{B0}$) is larger than that for the case of successful demand increasing research ($D_1B_1P_{B1}$). This finding applies to any fishery on a backward-bending supply curve as a result of a combination of heavy exploitation and inefficient fishery management. For all such cases, research which results in an increase in demand for the catching industry will actually make society worse off irrespective of the cost of the research. Finally, contrast this negative benefit from demand-inducing research in a heavily exploited open-access fishery with the substantial positive benefits (represented by the area $D_1A_1A_0D_0$ in Fig. 5) from the same type of research in the same fishery if it is efficiently managed.

The long-run effects of all other research which succeeds in having a direct impact on the catching sector can be represented by a shift of some type or

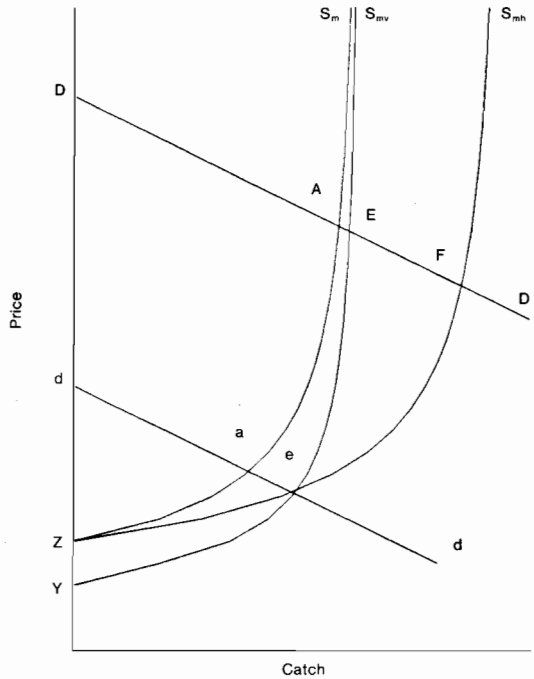


Fig. 6. Benefits from more productive fishing in an efficiently managed fishery.

other in the sustainable supply curve. Examples of possible output from this class of research include greater effective productivity of the fish stock, or improved efficiency of fishing gear, and/or lower cost of fishing effort. Various ways in which these types of research are likely to shift the sustainable supply curve are discussed in more detail in Lindner (1989). The following analysis is restricted to two types of supply shift, one being a horizontal shift to the right of the sustainable supply curve, and the other being a vertical downward shift. Possible impacts of these different types of supply curve shifts on an efficiently managed fishery are depicted in Fig. 6, and the corresponding impacts for an open-access fishery are illustrated in Fig. 7.

In the efficiently managed fishery illustrated in Fig. 6, the size of GARB generated in the long run by a horizontal shift of the sustainable supply curve from S_m to S_{mh} is represented by the area *Zae* for a lightly exploited fishery, and by the area *ZAF* for a heavily exploited fishery. The corresponding areas measuring GARB consequent on a vertical shift of the sustainable supply curve from S_m to S_{mv} are *ZaeY* and *ZAEY* respectively.

It can be seen from Fig. 6 that, other things being equal, research leading to a vertical downward shift of the sustainable supply curve in lightly exploited fisheries will generate larger GARB than an equivalent horizontal shift to the right of the supply curve (i.e. as drawn area *ZaeY* is larger than area *Zae*). However, as the intensity of exploitation of the fish stock increases, the size of GARB generated by a vertical downward shift will increase at a decreasing rate, while GARB generated by a horizontal shift will increase at an increasing rate. This finding suggests that, so long as the fishery is efficiently managed, research should concentrate on inducing a vertical downward shift of the sustainable supply curve while the fish stock is lightly exploited, but that the emphasis of the research program should shift towards finding ways of inducing a horizontal supply curve shift as the fish stock becomes more heavily exploited. In general, improved catching technology will tend to shift the sustainable supply curve vertically, while any new practices or knowledge which result in an effective increase in the biological productivity of the fishery will tend to shift the sustainable supply curve horizontally.

Figure 7 illustrates how the sustainable supply curve of an open-access fishery would be likely to shift in response to the same types of research. In contrast to the situation illustrated in Fig. 6, all rents are dissipated so the size of GARB consists entirely of any change in consumer surplus. For a lightly exploited fishery, either type of supply shift will result in lower prices, thus increasing consumer surplus. As drawn in Fig. 7, the size of this increase, which also measures GARB, is equal to the area $P_b bg P_g$ for both a vertical and a horizontal shift in the supply curve.

There is no such similarity in the size of GARB for different types of supply shift if an open-access fishery is heavily exploited. As can be seen from the intersection of the various supply curves with the *DD* curve in Fig. 7, while the effect of a horizontal shift still is to lower price (from P_B to P_H), a vertical downward supply curve shift results in an increase in price from P_B to P_G. Consequently, only those types of research that generate a horizontal shift to the right of the open-access sustainable supply curve will generate positive GARB in a heavily exploited fishery. As was the case for demand-increasing research, research into improved catching technology or other areas likely to cause a vertical supply curve shift will at best make society worse off by the amount of the wasted cost of the research, and if successful also will generate negative GARB (depicted by the area $P_G GBP_B$) in Fig. 7.

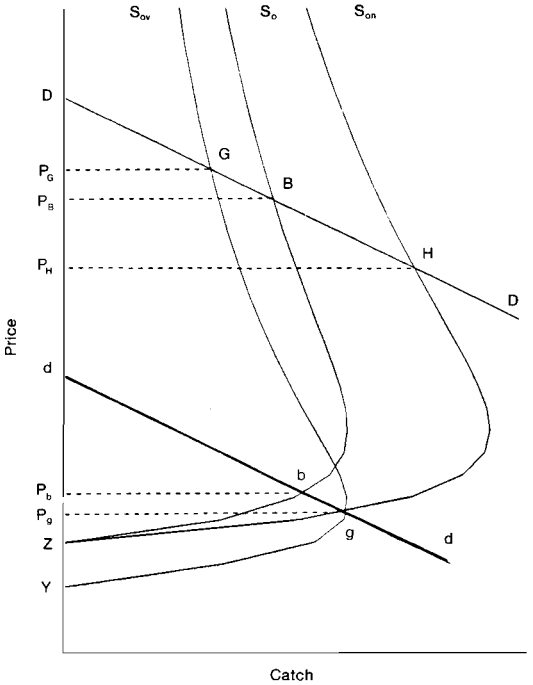


Fig. 7. Benefits from more productive fishing in an open-access fishery.

This possibility of negative GARB from a vertical downward shift in the sustainable supply curve again reinforces the point made earlier that it is important to introduce an efficient system of fishery management while the fishery is still lightly exploited. Once an open-access fishery is heavily exploited, certain types of research are not only guaranteed to make society worse off, but if they succeed also will make society even more worse off than if they do not. For other types of research, at best the level of GARB that can be generated in an open-access fishery will be some fraction of the potential GARB that could be realised if the fishery were efficiently managed.

References

Campbell, H.F., and Lindner, R.K. 1989. The Production of Fishing Effort and the Economic Performance of Licence Limitation Programmes. Paper presented to the 33rd Annual Conference of the Australian Agricultural Economics Society, Lincoln College, Christchurch, New Zealand, 7-9 February.

Clark, C.W. 1976. Mathematical Bioeconomics: the Optimal Management of Renewable Resources. New York, John Wiley & Sons.

Contant, R.B., and Bottomley, A. 1988. Priority Setting in Agricultural Research. Working Paper No.10. Netherlands, ISNAR.

Copes, P. 1970. The backward-bending supply curve of the fishing industry. Scottish Journal of Political Economy, 17, 69-77.

Davis, J.S., Oram, P.A., and Ryan, J.G. 1987. Assessment of agricultural research priorities: an international perspective. ACIAR Monograph No.4, 85 p.

Edwards, G.W., and Freebairn, J.W. 1984. The gains from research into tradeable commodities. American Journal of Agricultural Economics, 66, 41-49.

Evenson, R.E., Ruttan, V., and Waggoner, R. 1979. Economic benefits from research: an example from agriculture. Science, 205, 1101-1107.

Fishel, W.L. 1971. The Minnesota agricultural research resource allocation information system and experiment. In: Fishel, Walter L., (ed.) Resource Allocation in Agricultural Research. Minneapolis, University of Minnesota Press.

Freebairn, J.W., Davis, J.S., and Edwards, G.W. 1982. Distribution of research gains in multistage production systems. American Journal of Agricultural Economics, 64, 39-46.

Koestler, A. 1964. The Act of Creation. London, Hutchinson.

Lindner, R.K. 1989. Fishing Industry Research Benefits. Agricultural Economics Discussion Paper No. 7/89. Nedlands, School of Agriculture, The University of Western Australia.

Lindner, R.K., and Jarrett, F.G. 1978. Supply shifts and the size of research benefits. American Journal of Agricultural Economics, 1, 48-58.

Norton, G.W., and Pardey, P.G. 1987. Priority-Setting Mechanisms for National Agricultural Research Systems: Present Experience and Future Needs. The Hague, Netherlands, International Service for National Agricultural Research.

Wise, W.S. 1975. The role of cost-benefit analysis in planning agricultural R & D programmes. Research Policy, 4, 246-261.

Appendix A
Partial Derivatives of Expected Net Present Value of Research

$$E(NPV) = i^{-1}pG[(1+i)^n - 1](1+i)^{-(h+m+n)} - i^{-1}C[1-(1+i)^{-h}]$$

$$[\delta E(NPV)]/\delta C = i^{-1}[(1+i)^{-h} - 1]$$

$$[\delta E(NPV)]/\delta p = i^{-1}G[(1+i)^n - 1](1+i)^{-(h+m+n)}$$

$$[\delta E(NPV)]/\delta G = i^{-1}p[(1+i)^n - 1](1+i)^{-(h+m+n)}$$

$$[\delta E(NPV)]/\delta h = -hi^{-1}(1+i)^{-h-1}\ [pG[(1+i)^n - 1](1+i)^{-(m+n)} + C]$$

$$[\delta E(NPV)]/\delta m = -mi^{-1}pG[(1+i)^n - 1](1+i)^{-(h+m+n+1)}$$

$$[\delta E(NPV)]/\delta n = ni^{-1}pG[(1+i)^{-(h+m+n+1)}]$$

Models as Modes of Action: Frameworks and Strategies for the Development of Fisheries in the South Pacific

J. Brown and G. Waugh[1]

Abstract

Economic models serve as modes of action as well as aids to understanding. In this paper we first examine several of the strategies, for the future development of Pacific fisheries, that have emerged from ways of modelling this domain. The models considered range through explanations that specifically represent features of concern, such as employment, balance of payments, value added, to more general models such as the free-trade comparative advantage model and the rent-maximising market models. We suggest that the appropriate framework in the Pacific context is one that explicitly incorporates social and cultural features in its structure and recommend that vulnerability minimisation (cultural, social and economic) stands as an important criterion in sorting out modes of action. Second we examine some of the problems associated with the narrow positivist position that has emerged in economics. We conclude with the suggestion that as economists we make more modest recommendations, particularly when these claims may be taken to serve as modes of action in different cultural and social domains.

Introduction

THE Western-Central Pacific embraces one of the world's few remaining large and underutilised fisheries. Consequently, the creation of the Exclusive Economic Zone (EEZ) has added an important and different dimension to the resource base of the Pacific communities; important in terms of size, different in that exploitation is driven by international demand. The development of these fisheries, hopefully to the social and economic benefit of the Island peoples, is the underlying theme of this conference. More specific concern is with research programs, social, biological and economic. Western advisers, natural scientists, anthropologists and sociologists, and economists, have entered this domain, and sought in their different ways to offer research and development advice.

In this paper we are concerned with the role of economists and the status of economic models as explanations and as modes of action. Particularly, we draw attention to the problems that may be associated with the transfer of western-paradigm frameworks to different social and cultural systems. Western economic models range from those that directly represent specific features of concern or aims (maximum participation, employment, diversification, etc.) to those such as the free market trade model and the more specialised rent-maximising models that complement it. These models make various sorts of claims to objectivity. At best such claims should be viewed in the narrow sense that they merge comfortably with a shared cultural and social background, against which differences of economic emphasis can be accommodated. Consequently, the sorting out of alternative modes of action is simplified when confined to some agreed criteria, economic efficiency, GDP, or a narrowly defined index of

[1] Department of Economics, University of New South Wales, PO Box 1, Kensington, NSW 2033, Australia.

welfare. When Western models and modes of action are transferred to different cultural and social domains they may not be appropriate.

The Economic Perspective

One of the remaining legacies of the mercantilist system is concern with domestic participation in resource development. As later translated through the Keynesian paradigm, the management of national economies (supported by a foreign exchange system in accord with this) set the framework for post-World War II economic development. Whilst recognising the welfare gains from international trade (GATT) this framework sought to prevent the 'international tail from wagging the national dog.' Fundamental balance of payment disequilibrium was provided with a last resort adjustment mechanism in terms of the domestic currency/dollar (gold) exchange rate.

Current conventional wisdom generally denies the efficacy of this framework, and places emphasis on free-market outcomes. In some way such outcomes are in accord with those fundamental and basic market forces that 'ought' to be allowed unfettered sway in the economic domain; regulation of these forces is held as frustrating the path to economic efficiency and welfare gains. The derived policy thrust aims at gearing domestic resource allocation to international markets, at least to the extent that it is politically feasible. This places issues of domestic participation in a different framework.

But the comparative advantage framework cannot be squeezed into a positivist mould. Its theoretical forms and attributes cannot effectively be reduced to an observation sentence; that is, a statement in which the related concepts can be confronted with experience, where truth or falsity can in some way be determined (Hookway 1988). There is no support for the free market comparative advantage model here, and support cannot be sought from the presuppositions of models (see Appendix).

In 1848 John Stuart Mill warned political economists against this line of thinking. Referring to political economists, and English political economists above others, he said: 'They are apt to express themselves as if they thought that competition actually does whatever it can be shown to be the tendency of competition to do' (Mill 1891 edition). He was pointing out that ostension in the competitive model does not necessarily extend to the actual economic domain.

The standing of degrees of domestic participation representations (models) varies according to the framework in which they are offered. In a mercantilist Keynesian framework they stand as part of the framework. This does not apply in a comparative advantage framework. Here they act as a set of algorithms used merely to select the rent-maximising degree of domestic participation. This degree of domestic participation is then held to accord with the presuppositions of the trade framework.

Despite this, or because of this, the mercantilist legacy has retained considerable sway, especially for those directly responsible for 'catch-up' economic strategies in developing nations. This is because domestic participation has never been solely based on economic efficiency; national standing and status have always strongly influenced development plans.

Domestic Participation in a Free-Trade Framework

Munro (1984, 1985) has developed the argument that the case for participation of the distant water fishing nations is a variant of the case for trade. Fee fishing, where the foreign nation harvests the resource within the EEZ, is the equivalent of the domestic country importing harvesting resources and exporting their fish stock: the foreign nation harvests the fish and the domestic nation obtains the rent in the form of licence fees. In the same way processing by foreign nations, either on mother-ships or abroad, is equivalent to importing processing services. In principle, Munro argues, this is equivalent to importing transport services through merchant shipping.

Consequently, the case for fee fishing rests on the case for trade. Simply stated, the argument for trade is that welfare for both trading partners is raised if trade is allowed to flow freely. Countries can export those commodities in which they have a comparative advantage and import those in which they have a comparative disadvantage. The Island states may have an advantage in the ownership of the tuna resources which pass through their EEZ, but a comparative disadvantage in the harvesting and processing of them (Waugh 1988). The struggling domestic harvesting and processing industries in the Pacific provide evidence for this view (see for example Waugh 1986, 1987).

The case for domestic participation in harvesting and processing, as expressed in development plans and some of the literature on Pacific development,

rests on gains from value added, employment, import substitution, and industrialisation. These perceived gains, it is often argued by economic rationalists (market economists), may be largely illusory. Each will be considered in turn.

The first argument is concerned with the extent of the value added when the Island's own capital and labour is used to increase the market value of harvesting and processing. This value added argument has been used to gain support for domestic processing facilities, with both Fiji and Solomon Islands providing examples. A simple example illustrates the fallacy of the argument in economic terms.

'Value-added' is the sum contribution of capital and labour to the overall value of the final product: so that if the final product sells for $100 and raw materials counted for $60, then $40 is considered the value-added. The assumption is often that this $40 value-added is all gain to the economy. In practice, part of it or all of it and sometimes more than all of it may be a cost to the economy; for if the $40 represents displacement of capital and labour from other productive activities then there can be no net gain to the economy. It is not the value added which is important so much as the net value-added, that is the value-added after allowing for the opportunity costs of the capital and labour.

Past difficulties of the processing facilities in both Vanuatu and Fiji suggest that the net value-added may well be negative. In Fiji the Pacific Fishing Company PAFCO was formed in 1963 and in 1986 the Fijian Government held a 29% interest with its Japanese partner C. Itoh. However, lack of profitability led Itoh to announce its intention to withdraw in 1987, and the Fijian Government has continued to operate independently.

The major supplier of fish to PAFCO is the government-owned Ika Corporation. Despite the input of large capital resources, the Ika Corporation had been in difficulties for a number of years. Although current figures are not readily available, Ika had been accumulating losses. A similar situation existed with the South Pacific Fishing Company in Vanuatu (Waugh 1987). Solid empirical evidence that net value-added is negative for small harvesting fleets in the Pacific is not available; however, in a different region, a recent empirical study by Comitini and Hardjolukito (1986) for Indonesia, shows how in some cases net national income can be reduced by domestic investment in tuna harvesting facilities.

The second argument often used is the employment argument: government involvement and joint ventures in harvesting and processing increase the opportunities for local employment. This has been the reasoning in the establishment and maintenance of processing facilities in Fiji and Solomon Islands, and also one of the reasons why other Island states are content to travel the same path. There is a certain appeal and ring of validity about the argument, but economic rationalists argue that there are two difficulties that need to be borne in mind. Firstly, the generation of employment in this way has an associated opportunity cost; if the increase in employment is merely replacing employment in another sector there has been no real economic benefit. Secondly, considerable justification is needed to support any argument that suggests that propping up an inefficient industry is the best way to generate employment.

The third common argument is the balance of payments argument, and it has been a premise of much of the argument for fisheries development in the South Pacific. By expanding domestic activity in fishing, imports can be reduced, domestic products substituted for imported fish products, and the balance of payments improved. Indeed, the high level of imports of fish products into these Island states makes in understandable why this argument has become strongly embedded in development plans. However, the economic rationalists point out that it is important to realise that substitution of expensive domestically produced fish products for the cheaper imported fish products lowers the welfare of those Island consumers who now must pay a higher price, or those who now subsidise the relatively inefficient industry through taxation. It also needs to be understood, they argue, that money spent abroad on imported fish products can only be respent back in the domestic economy.

The final argument considered here is the industrialisation argument: the domestic industry, once it has acquired the technology and skills, will eventually be able to compete in the international market. This is a specific application of the general infant industry argument. The counter claim by the economic rationalists rests on the benefits and costs of subsidisation. If it were true that the domestic industry may reach maturity in this way, then it needs to be demonstrated that the discounted net benefits outweigh the economic costs that have been incurred while the industry reaches maturity. Further, they claim that there are very high costs in

misapplying the infant industry argument in small economies which may in the long term be left to continuously subsidise an industry that never reaches maturity. Whereas it may not be too critical if vessels in the United States or Australia are left idle due to a failed venture, or if processing plants on the west coast of the United States close down as circumstances change, similar failures in very small countries, with national incomes in some cases of less than US$50 million, do become critical. The Island states need to be right at the first attempt.

There is, then, a strong case to be made that the Island states have a short-term, and possibly long-term, comparative disadvantage in offshore harvesting and processing of tuna with their best strategy focusing on the attempt to secure the greatest possible licence fees for their offshore resources. This is not to deny that there may be room for a small domestic fleet — trade theory teaches that specialisation is rarely complete — but the emphasis is likely to be on small for a considerable time.

More generally, Munro has shown that fee fishing fits neatly into the free-trade comparative advantage framework. This is not the type of framework that sorts out modes of action, as it features only forms and attributes. The strategy that best accords with this framework (on rent-maximising grounds) is determined through models or algorithms that directly represent degrees of domestic participation. The trade model merely gives out the message that if the assumptions of the model are met, or if they are approached (by deregulation for example), the basic and fundamental market forces will in some way ensure that global resources are allocated in a way that ensures economic efficiency and mutual welfare gains. In terms of this framework, representations that feature degrees of domestic participation are seen as selecting a strategy from those that range from zero to total domestic participation: or in this case from fee fishing to total domestic harvesting and processing.

An Alternative Framework

Nevertheless, Munro's clarification has added some respectability to fee fishing, at least when viewed through Western capitalists' eyes. What is not so clear is that this sort of respectability is embraced by the Pacific community. In broader terms it has not been established, in an imperfect world, that policy changes that move actual conditions in the direction of the assumptions of the comparative advantage model necessarily result in increased efficiency or mutually beneficial outcomes, especially for very small developing countries. Such contentions only follow if the free trade-comparative advantage model is taken as revealing what is universally 'really real' that is as some sort of natural law that human society frustrates only at its welfare peril. This is a philosophical issue of some import to economics (see Appendix). Concern here, however, is with the social and economic welfare of the Pacific community and in this domain the global welfare-maximising framework smacks of pedantry.

We suggest that serious consideration ought to be given to a more appropriate framework for sorting out and justifying fisheries resource development in the Pacific region. Such a framework would explicitly recognise that the basic and fundamental forces (if there are any) are cultural and social. There is nothing honorific or right about particular cultural and social features: they are just there, are structured and run deep. Serious problems emerge when explanations and modes of action challenge and frustrate traditional values which on historical evidence have a strong tendency to reassert themselves, in the process often upsetting the best intentioned development plans. Models and modes of action driven by different value systems may not prove appropriate for other value domains, more particularly an ideal or universal model that provides no space for cultural and social features.

However, this does not mean that economic efficiency, especially when international competition and markets are considered, should not be recognised and attended to. What it does mean is that this concern should not necessarily be the primary or dominant one. The primary concern could well be with minimising the vulnerability of Pacific ways of working the world. Here it is recognised that traditional society is valuable, and deserves the concern of those who seek to advise on resource development. It may be more appropriate to consider a vulnerability framework for sorting out fisheries development strategies; that is, a framework that directly represents cultural and social features.

Such a framework (Fig. 1) is set against the free trade-comparative advantage one. The diagram illustrates that the trade framework is driven by a particular value system, but is generally presented by the proponents of this line of thinking as detached; that is objective or scientific. This gives

the impression that the rent-maximising algorithms used to provide specific content to this framework are value-free.

In broad terms the vulnerability framework indicates that it is not possible or desirable to separate knowledge from values. The decision-making subframework contains cultural, social, biological and economic categories. When content is given to these categories (and this content will differ for different world views) the appropriate action is determined through a matrix of cultural, social, biological and economic factors; the weight given to each of these factors being decided by those directly concerned with, and affected by, development actions.

We do not, and cannot, suggest specific content for these categories in the Pacific social domain. But if it is considered that culture and custom are basic and fundamental features that should be attended to, it follows that basic research in these areas must play a role if Western advisers are to continue offering advice on development plans in the Pacific region (see Ruddle These Proceedings).

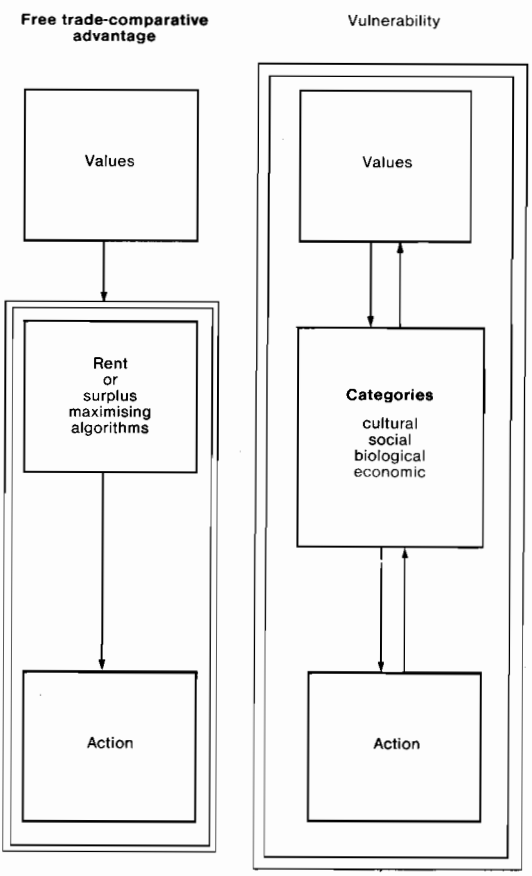


Fig. 1. Development frameworks.

From this framework fee fishing could well emerge as the most appropriate mode of action. This would accord with the comparative advantage outcome. This conclusion, however, is reached by a different path, a path that recognises the vulnerability of Pacific society to the impacts of international forces.

We recognise that the revenues from fee fishing will have an impact on Pacific custom. This will vary depending on how the revenue is distributed, whether in accord with traditional ways of sharing, or ways driven by a value system that features individual self interest and private ownership, features that are generally accepted as fundamental and necessary in Western capitalist society. This is an internal matter on which we consider it impertinent to comment.

It is clear that domestic participation in harvesting and processing, given the size of the resource and where output is geared to international markets, takes on a different dimension in a vulnerability framework. Domestic participation necessitates a different way of working the world, a different sort of industrial organisation, a different reward system, and a different institutional framework, amongst other things. This type of enterprise cannot be isolated from traditional ways of working the world in other sectors of the community. The switch and sway of international forces, the aspirations of foreign participants (joint venturers and investors) would necessarily have an impact on traditional culture and custom, particularly in crisis. Foreign currency debt could deepen and widen the impact. Foreign creditors who rightly demand their 'pound of flesh' have not been, and are not likely to become, serious respecters of traditional culture and social systems. Recent and current events in Central and South America strengthen this concern.

There are also direct environmental effects to consider. Fluctuations in harvest, due to overfishing or random and temporal environmental changes, would be more strongly and widely transmitted to the Pacific community under domestic participation outcomes. There is no guarantee of the findings of biological research, where explanation is often based on meagre and deficient data. It is important that decision-makers are not swayed by the impression of precision given by these representations, more particularly the economic models that make the sort

of existence claims that biologists would not entertain.

The formal representation of sustainable yield serves to illustrate this concern. This concept is given ostension through the population yield relationship. Although biologists know and accept that this ostension does not extend to the seas and ocean, sustainable yield has been eagerly embraced by those fisheries economists who prefer to proceed along the rent-maximising path. With great facility the population yield curve is converted to a total revenue curve and ostension given to the rent-maximising output by the addition of a total effort or cost function. But this ostension is only in the model. The variability of international market forces, environmental effects, models that do not give operational ostension as modes of action amongst other things add up to a complex matrix of uncertainty that seriously challenges, and diminishes, the importance of the rent-maximising outcome. The efficacy of this outcome is only supported by the presuppositions of the model. The collapse of the tuna market at the beginning of this decade, and the closure of nearly all processing facilities on the west coast of the United States, had little effect on the United States economy. It is possible to imagine the serious social effects of closures if these facilities had been located in the Pacific region.

Secondary effects of crisis arise when domestic participation strategies are upset by debt servicing problems. This has its effect on the wider community often making necessary different ways of working the world: cash crop expansion at the expense of traditional food crops and the like as well as externally imposed constraints. Serious social tensions generally follow. These issues are important and have been highlighted in recent times. They are issues we feel 'ought' to be attended to in an operational framework.

An important issue remains. The Pacific peoples still may not view fee fishing as the most desirable outcome. Emerging from a global framework, fee fishing could well be viewed as a Western, capitalist trick, as this mode of operation may not give the immediate impression of being development at all. It could well be taken as a locking-in strategy. For developing small economies this framework leads to a circularity; stage of human resource development determines comparative advantage, and comparative advantage determines and fixes stage of development. There is no avenue here for domestic participation in fishery resource development, no direct employment effect, skill enhancement, construction, infrastructure development, the very indicators that are commonly understood as measures of economic development.

Economists give considerable emphasis to secondary effects. These effects have, no doubt, been of considerable benefit in more developed and diverse economies. It is not so evident that they apply to the small Pacific economies. The revenues from fee fishing could well be dissipated in the consumption of imported goods, increasing consumer welfare, but not necessarily domestic development in the commonly accepted sense.

Whether fee fishing would be more readily accepted emerging from a vulnerability minimising framework is an open question. But at least concern is given to protecting those things that are traditional and valuable from the intrusion of different and often disagreeable world views.

Conclusion

For economists, and more particularly market economists, a change of attitude to development of this order is unlikely, because of the increasingly narrow stance that the discipline has taken, and is taking. Much of economics is speculative hypothesising (the competitive model for example) as is much of natural science. Admitting this does not separate economics from science, if anything it unifies it with science.

We prefer to recognise the importance of a matrix of cultural, social and economic factors as a development framework. We suggest that economists be more modest in what they claim to know, and how they go about knowing. Here the language of the common understanding could well serve as a guide. When someone asserts something that is strange, new or unexpected it is common to ask 'How do you know?' In this way, the common understanding indicates that it is not possible to separate what we know from how we know.

For the Pacific Island people development issues are important. For the status of economics, continuing this narrow stance puts at risk any respect from the scientific community in general. In questioning the appropriateness of economic models as explanations, and as modes of action in this different cultural and social domain, we recognise that we may have overstressed our case. But this is a part of the art of persuasion and we do not expect anyone to think in our terms if they prefer not to.

References

Comitini, S., and Hardjolukito, S. 1986. Economic benefits and costs of alternative arrangements for tuna fisheries development in the exclusive economic zone: the case of Indonesia. Ocean Management, 10.

Friedman, M. 1953. The methodology of positive economics, M Friedman, Essay in Positive Economics, University of Chicago Press, Chicago.

Hirshleifer, J. 1988. Price Theory and Applications, 4th ed., Prentice Hall, New Jersey.

Hookway, C. 1988. Quine, Language, Experience and Reality, Polity Press, Cambridge, 187–190.

Mill, J. 1848. Principles of Political Economy, George Routledge & Sons, London, 1891 edition, 170–171.

Munro, G. 1984. Foreign access to EEZs and the derivation of coastal benefits: methods and techniques. Report of the Expert Consultation on the Conditions of Access to the Fish Resource of the Exclusive Economic Zones, FAO Fisheries Report No. 293, Rome: 143–151.

1985. Coastal states, distant water fleets and EFJ: some long-run considerations. Marine Policy, 9, 2–15.

Ruddle, K. 1989. Traditional Sole Property Rights and Modern Inshore Fisheries Management. These Proceedings.

Walker, D. 1988. Ten major problems in the study of the history of economic thought. Presidential Address to the American History of Economic Thought Society, H.E.S. Bulletin, 99–113.

Wartofsky, M. 1979. Models, Representations and the Scientific Understanding, D. Reidel Publishing Coy., Dordrecht, Holland.

Waugh, G. 1986. The Development of Fisheries in the South Pacific Region with Reference to Fiji, Solomon Islands, Vanuatu, Western Samoa and Tonga. Island/Australia Working Paper No. 86/2, National Centre for Development Studies, Australian National University, Canberra.

1987. The Collection of Rent in the South Pacific Tuna Fishery. Island/Australia Working Paper No. 87/3, National Centre for Development Studies, Australian National University, Canberra.

1988. Development, economics and fishing rights in the South Pacific tuna fishery. Paper delivered to the workshop on Scientific Foundations for Rights Based Fishing, Reykjavik, Iceland June 27–July 1, 1988.

Waugh, G., and Brown, J. 1988. Strategies for Development of Fisheries Policy in the South Pacific. Paper delivered to the Australian and the South Pacific Conference, University of New South Wales, December.

Appendix: Ideal Models and Reality

An important issue emerges from the view taken of ideal and universal models and their relation to reality. An increasing number of economists explicitly (and implicitly) speak as if ideal models explain what is 'really real' (Wartofsky 1979, 29–39). A few examples of explicit claims may suffice to illustrate this.

Hirshleifer (1988, 13–14) asserts: 'In its scientific aspects economics is strictly positive. It answers the question "what reality is like?" . . . As astronomy has Newton's principle of universal gravitation, and biology Darwin's principle of natural selection, economics also has a great unifying scientific conception. Its discovery was like Newton's and Darwin's one of the important intellectual achievements of humanity.'

Hirshleifer was referring to the 'invisible hand' presumably discovered by Adam Smith. Hirshleifer proceeds to elaborate this 'great law' by translating it into the language of the common understanding: 'More sophisticated individuals know with Adam Smith that you often help others by trade more than by direct aid. Nevertheless, it is a little difficult to understand just why an economic system of untrammelled selfishness does not lead to mutual harm or even total chaos.' The rest of the text goes on to explain this.

In similar vein but perhaps with more subtlety, Friedman (1953, 3–43) draws much out of the comparison of an economic law with Gallileo's law of falling bodies. We are prepared to accept that as atmospheric conditions approach (but not reach) a void that the measured acceleration of a falling body approaches that given by Gallileo's formula. We are prepared to accept that for most practical purposes it is close enough. We are even prepared to accept that it may be a useful analogy. We suggest, however, that this analogy is a false one when taken literally and seriously. We take the point (physicists may not) that gravity is an independent concept. But the so-called economic laws are dependent concepts.

Finally, Walker (1988) in his presidential address to the American History of Economics Society lauds the fact that economics has divorced itself from philosophy, politics, morals and the like (hopefully not from the philosophy of science). He maintains economics has become objective and scientific. He proceeds to dispose of normativism, subjectivism and multiplicism and asserts that through positivism basic reality can be given ostension. He gives support to this assertion (and it is only an assertion) by telling a little story, second hand but supposedly of some import: 'We should emulate the clear vision of Vilfredo Pareto, expressed strikingly at a

conference at which he had spoken about the natural laws of economics. Gustav Schmoller, then at the heights of his glory, interrupted him with the emphatic assertion that there are none. At the end of the session Pareto asked Schmoller if he knew of a restaurant where the meals are free. Schmoller answered that he knew of some good inexpensive ones but that of course, there is no such thing as a restaurant where meals are free, whereupon, Pareto answered with the remark: "There you see at work the natural law of economics!" and reduced him to silence.' (Walker 1988, 110).

We prefer to think that Schmoller shook his head and said to himself 'why bother.' Putting this in positivist terms Schmoller's reply '. . . that of course there is no such thing as a restaurant where meals are free' can be viewed as an observation statement that can presumably be verified (or falsified) by confronting experience. The support, for or against, that this gives to Pareto's assertion that the theoretical relationships he was proposing amounted to a natural economic law completely escapes us.

In addition there are many implicit claims made by economists that can only be supported by the acceptance of this positivist view. Those economists who maintain that any movement of actual conditions towards the ideal (deregulation, for example) leads always, and at all times and places, to increased economic efficiency and mutual welfare gains tread in the path of the natural law economists.

We do not like this path; we prefer another. We prefer to view ideal laws as ideal fictions, that is as dependent, not independent concepts. They are useful as benchmarks for ordering. They also serve as a valuable heuristic for economic theorising. We do not and would not deny the contribution of a priori models to economic understanding. What we do question is the efficacy of forcing these models into a positivist framework. We also accept that if there were natural laws in economics, and if they could be discovered by reasoning, then it would make little sense for society to frame laws that conflict with them. We may even accept that concern for different cultural and social domains would be of no import if all could be resolved by obeying natural law.

But there remain two critical questions. How do we know when we have found the natural law? and what do we do in the meantime? We can offer no answer to the first question, we cannot even suggest how we should go about finding it. To the second question we can only suggest that in the meantime we be modest in making claims about what we know and the way we go about knowing.

Participants

Dr Sam Blay
Faculty of Law
University of Tasmania
GPO Box 252C
Hobart Tasmania 7001

Mr Jack Brown
Department of Economics
University of New South Wales
PO Box 1
Kensington NSW 2033

Professor Harry Campbell
Department of Economics
University of Tasmania
GPO Box 252C
Hobart Tasmania 7001

Ms Pam Chapman
Research Services Officer
Economics and Farming Systems
ACIAR
GPO Box 1571
Canberra ACT 2601

Dr David Doulman
Deputy Director
Forum Fisheries Agency
PO Box 629
Honiara Solomon Islands

Mr Semisi Fakahau
Principal Fisheries Officer
Ministry of Agriculture, Fisheries and Forests
PO Box 14
Nuku'alofa
Kingdom of Tonga

Mr Tony Harrison
Department of Sea Fisheries Tasmania
GPO Box 619F
Hobart Tasmania 7001

Dr Richard Herr
Department of Political Science
University of Tasmania
GPO Box 252C
Hobart Tasmania 7001

Mr Noah Idechong
Deputy Chief
Marine Resources Division
PO Box 100
Koror Palau PW 96940

Dr Bob Johannes
Division of Fisheries
CSIRO
GPO Box 1538
Hobart Tasmania 7001

Dr Bob Kearney
Director
Fisheries Research Institute
NSW Agriculture and Fisheries
PO Box 21
Cronulla NSW 2230

Ms Dorosthy Kenneth
Economist
Fisheries Department
Ministry of Agriculture, Forestry and Fisheries
Private Mail Bag
Port Vila Vanuatu

Dr Mike King
Australian Maritime College
School of Fisheries
PO Box 21
Beaconsfield Tasmania 7277

Mr Yoshihiro Kuronuma
Department of Economics
University of Queensland
St Lucia Qld 4067

Professor Bob Lindner
School of Agriculture
University of Western Australia
Nedlands WA 6009

Dr A. David McDonald
Department of Economics
University of Tasmania
GPO Box 252C
Hobart Tasmania 7001

Mr Alistair McIlgorm
Australian Maritime College
School of Fisheries
PO Box 21
Beaconsfield Tasmania 7277

Mr Reg MacIntyre
Consultant (Communications)
ACIAR
GPO Box 1571
Canberra ACT 2601

Mr Kevin Mansu
Commercial Investment Division
Department of Finance and Planning
Post Office Wards Strip
Papua New Guinea

Dr Ken M. Menz
Research Program Coordinator
Economics and Farming Systems
ACIAR
GPO Box 1571
Canberra ACT 2601

Professor Gordon Munro
Department of Economics
University of British Columbia
997–1873 East Mall
Vancouver British Columbia
Canada V6T 1W5

Mr Keith Owen
Australian Fisheries Service
Department of Primary Industries and Energy
GPO Box 858
Canberra ACT 2601

Dr Tony Owen
Department of Economics
University of New South Wales
PO Box 1
Kensington NSW 2033

Dr Richard Piotrowicz
Faculty of Law
University of Tasmania
GPO Box 252C
Hobart Tasmania 7001

Mr Michael Riepen
Economic Advisor
Fisheries Department
Ministry of Agriculture, Forestry and Fisheries
Private Mail Bag
Port Vila Vanuatu

Mr Len Rodwell
Assistant Secretary, Policy,
Planning and Licensing Branch
Department of Fisheries and Marine Resources
PO Box 165 Konedobu
Papua New Guinea

Dr Ken Ruddle
National Museum of Ethnology
Senri Expo Park Suita
Osaka 565 Japan

Professor Tony Scott
Department of Economics
University of British Columbia
997–1873 East Mall
Vancouver, British Columbia
Canada V6T 1W5

Professor Clem Tisdell
Department of Economics
University of Queensland
St Lucia Qld 4067

Dr B. Martin Tsamenyi
Faculty of Law
University of Tasmania
GPO Box 252C
Hobart Tasmania 7001

Mr James Uan
Fisheries Division
PO Box 276
Bikenibeu Tarawa
Kiribati

Dr K. Roger Uwate
Senior Economist
Forum Fisheries Agency
PO Box 629
Honiara Solomon Islands

Mr Robert Vonole
Senior Fisheries Economist
Department of Fisheries and Marine Resources
PO Box 165
Konedobu Papua New Guinea

Dr Geoff Waugh
Department of Economics
University of New South Wales
PO Box 1
Kensington NSW 2033

Dr Steve Williams
Head of Programme (Marketing)
School of Management
Darling Downs Institute of Advanced Education
Toowoomba Qld 4350

ACIAR PROCEEDINGS SERIES
RECENT TITLES

No. 16. Australian acacias in developing countries: proceedings of an international workshop held at the Forestry Training Centre, Gympie, Queensland, Australia, 4–7 August, 1986. John W. Turnbull (ed.), 196 p., 1987.

No. 17. Ticks and tick-borne diseases: proceedings of an international workshop on ecology of ticks and epidemiology of tick-borne diseases, held at Nyanga, Zimbabwe, 17–21 February, 1986. R.W. Sutherst (ed.), 159 p., 1987.

No. 18. Food legume improvement for Asia farming systems: proceedings of a workshop held at Khon Kaen, Thailand, 1–5 September, 1986. E.S. Wallis and D.E. Byth (ed.), 341 p., 1987.

No. 19. Technology change in postharvest handling and transportation of grains in the humid tropics: proceedings of an international workshop held at Kuala Lumpur, Malaysia, 10–12 September, 1986. B.R. Champ, E. Highley and J.V. Remenyi (ed.), 208 p., 1987.

No. 20. Management of wild and cultured seas bass/barramundi (*Lates calcarifer*): proceedings of an international workshop held at Darwin, Northern Territory, Australia, 24–30 September, 1986. J.W. Copland and D.L. Grey (ed.), 210 p., 1987.

No. 21. Banana and plantain breeding strategies: proceedings of an international workshop held at Cairns, Australia, 13–17 October, 1986. G.J. Persley and E.A. De Langhe (ed.), 187 p., 1986.

No. 22. Bulk handling and storage of grain in the humid tropics: proceedings of an international workshop, Kuala Lumpur, Malaysia, 6–9 October, 1987. B.R. Champ and E. Highley (ed.), 296 p., 1988.

No. 23. Transport of fresh fruit and vegetables: proceedings of a workshop held at CSIRO Food Research Laboratory, North Ryde, Sydney, Australia, 5–6 February, 1987. P. Ferrar (ed.), 75 p., 1988.

No. 24. Smallholder agricultural development in Tonga: proceedings of a workshop held at the Institute for Rural Development, University of the South Pacific, Nuku'alofa, Tonga, 12–13 May 1988. K.M. Menz (ed.), 50p., 1988.

No. 25. Fumigation and controlled atmosphere storage of grain: proceedings of an international conference held at Singapore, 14–18 February 1989. Bruce Champ and E. Highley (ed.) (In press).