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**REVIEW OF ACIAR/ICLARM RESEARCH ON THE CULTURE
OF COMMERCIALY IMPORTANT CORAL REEF INVERTEBRATES
IN THE PACIFIC ISLANDS REGION
9–20 FEBRUARY 1998**

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**REVIEW OF ACIAR/ICLARM RESEARCH ON THE CULTURE OF
COMMERCIALY IMPORTANT CORAL REEF INVERTEBRATES IN THE
PACIFIC ISLAND REGION
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Projects under review:

- **FIS/95/42** "Large scale village growout trials for giant clams" Phases 1 and 2
- **FIS/96/235** "A collaborative investigation of options for spat collection and hatchery production of pearl oysters in the Central-Western Pacific"
- **FIS/95/703** "Development of methods for the mass-rearing of tropical sea cucumbers for the purpose of enhancing wild stocks"
- **FIS/94/117** "Use of marine protected areas to restore and manage tropical multispecies fisheries"

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Background

Since 1983-84 ACIAR and ICLARM have variously jointly and independently supported a coherent series of research initiatives aimed at the development of low to medium technology mariculture in the Pacific Islands. The culture of high value and desirable food species was seen as a means of providing food and income to atoll and village communities (where economic opportunities are limited) and as a potential mechanism to replenish and possibly enhance depleted or threatened coral reef fisheries resources.

This research concentrated initially on the hatchery culture and growout of several species of giant clams (*Tridacnidae*) with more recent attention given to trochus (*T niloticus*), blacklip pearl oyster (*P margaritifera*) and sea cucumbers (*Holothuridae*). Over a fourteen-year period ACIAR has provided some A\$6 million to support research into the mariculture of commercially important marine invertebrates. ICLARM has made research investments of a similar scale, while AusAID and other donors have supported several major development initiatives in support of mariculture activities in the Pacific Islands. The South Pacific Commission provides technical advice in this area on request to member countries, and has recently held discussions with ICLARM and the FAO South Pacific Regional Aquaculture Development Program regarding possible future arrangements for technical, research and advisory arrangements in aquaculture for Pacific Island countries.

The purpose of this review was defined by the Australian Centre for International Agriculture Research (ACIAR) as "To undertake a technical and cost benefit evaluation of past and ongoing ACIAR and the International Centre for Living Aquatic Resources Management (ICLARM) supported research on coral reef based mariculture in the Pacific Islands to determine realised and future benefits from the work and to identify productive avenues for future action. The review took the form of a desk study of relevant published and unpublished material, followed by travel to Solomon Islands for discussions and inspection of hatchery and research sites, and participation in a stakeholder workshop attended by invited aquaculture specialists from several Pacific Island countries.

Summary of Review Findings

In accordance with the terms of reference provided by ACIAR this review covers a technical and cost benefit evaluation of ACIAR and ICLARM supported projects on coral reef mariculture in the Pacific Islands.

The review team was most impressed by the quality of research being carried out in each of the four major projects (on giant clams, pearl oysters, sea cucumbers and marine reserves), and the relevance of the work to village communities in Pacific Island countries. Much of the success of the current projects was attributable to the commitment by ICLARM and ACIAR to the maintenance of a long-term, international standard research infrastructure within the region. The exceptional abilities of the two senior scientists and their commitment to international peer review of their work have greatly enhanced ICLARM and ACIAR's reputations within the region and beyond.

Findings relevant to specific projects and future opportunities are summarised in the following list of recommendations:

(Note: The recommendations have been recorded by topic to assist their consideration by the meeting.)

PROJECT SPECIFIC COMMENTS

i) Giant Clams

Recommendation 1

The review team is of the opinion that the correction or otherwise of any gender bias is a culture-specific issue and, hence, the responsibility of the appropriate authorities in each country. The team believes that the relevant Government authorities would approve efforts such as those which encourage women to develop the live coral or clam industries, however, it stresses that such approval should be formally documented. **Recommendation: ICLARM seek formal approval for any efforts to alter gender bias.**

Recommendation 2

The benefits of having basic business plans prepared and having an experienced marketing consultant cannot be over-emphasised. **Recommendation: ICLARM actively pursue support for both the preparation of basic business plans which meet the needs of farmers at village level and in situ participation by an experienced marketing consultant in the placement of the first trial shipments of clams to each of the selected Asian markets.**

ii) Sea Cucumbers

Recommendation 3

Notwithstanding the prima facie evidence that this project is likely to produce net economic benefits, there is a need to undertake and publish a comprehensive study of demand and supply for sea cucumbers that might be harvested from the Pacific. Transport logistics and costs are likely to differ throughout the region and each country needs to be aware of these. Furthermore, the size of potential market also needs to be estimated using appropriate economic techniques. **Recommendation: Funding for a regional study of demand and supply for sea cucumbers be pursued. SPC could be the appropriate body to seek this funding. The research would be done by persons or institutions with the relevant economic expertise.**

Recommendation 6

The work at the Coastal Aquaculture Centre has great value to the broader conservation, enhancement, restocking and marine ranching debate. By proving that the species can be bred artificially the work has confirmed the potential for species to be saved from overfishing to extinction. The use of closed areas to allow resources to recover has demonstrated the value of closures for protection of species and perhaps even for the restoration of adjacent areas through

input of juveniles and larvae from those areas which are closed (refugia). The further use of closures to facilitate the recovery of target species which are subsequently harvested is an example of ranching of natural resources. The restocking of depleted areas with hatchery bred juveniles, for example sea cucumbers, and the subsequent harvesting of these juveniles is a further example.

The review team believes that the conservation value of aquaculture would be easier to demonstrate, and resulting discussion improved, if ICLARM and ACIAR improve the definition of the objectives of their conservation work. Uncertainty and inconsistencies in the use of terms relating to the conservation, restoration, enhancement and increased productivity of wild and cultured stocks should be clarified. **Recommendation: ICLARM develop and use precise definitions of the major terms used to describe the restoration of species and environments and the use of closed areas and the introduction of juveniles of key species for conservation and fisheries management purposes.**

iii) Pearl Oysters

Recommendation 4

The ICLARM proposal to have at least one large farm to which village producers provide oysters is untried and may have problems. The need for a significant commercial-scale operation in the Solomon Islands is acknowledged and this could be the case in other countries. But the risks associated with having a monopoly must be assessed. Care will be needed to ensure that village people benefit appropriately from activities carried out in their area. ICLARM staff are aware of this issue but they will need support, probably from regional economic assessment agencies. The socio-economic impacts of alternative models should be investigated. **Recommendation: ICLARM seek support to have the likely social and economic impacts of pearl farming in selected countries in the region assessed. A range of options, including the concept of one, or more, large-scale operators in each country, need to be analysed.**

Recommendation 12

The current experiment to ascertain the quality of pearls produced from seeded oysters in the Solomon Islands should be followed by further research on factors which influence pearl production and quality. This work would, of course, presuppose that the quality of pearls produced in this area, or in other countries benefiting from this project, is adequate to support an economically viable industry. **Recommendation: Upon confirmation of adequate quality of artificially seeded pearls grown in the Solomon Islands, ICLARM commit to further research to support the establishment of pearl farming industries.**

iv) Marine Reserves

Recommendation 5

As the Arnavaon Is project is not scheduled for completion until April 1999 it is as yet too early to assess the full benefits or to evaluate what follow-up action might be required. It is already apparent that the project will have considerable benefit for the assessment of alternative management strategies for the protection, restoration and/or enhancement of coastal invertebrates

in the Pacific Island, and presumably Asia, region. In addition to the benefits related to the management of these species there will be spill-over benefits to the debate of tenure and fishing rights.

It is most likely that there will be follow-up activities somewhere in the region once the project has been concluded. It is reasonable to anticipate that the results from this project will provide guidance as to the type of experimentation which may further help in the management of in-shore invertebrate resources. It is too early to prescribe measures for taking advantage of that guidance.

Recommendation: If the results of the marine conservation area study are equivocal, but encouraging, ICLARM consider extending the monitoring program. Clear objectives and milestones for any extension would need to be developed.

v) Reeffish Capture/Culture

Recommendation 13

The review team believes that involvement in some form of finfish aquaculture at the CAC is desirable. As discussed in section 1(iii) we have some reservations about the current proposals for new projects. The international aquarium trade is successfully targeted by Pacific Island fishers through exporters and if this industry needs research support then it might be more appropriate to breed one or more of the most popular, presumably highly priced, species. Perhaps one of the rarer species should be bred. It would seem more appropriate for village people to grow out hatchery bred juveniles in a monoculture, than to tangle with the vagaries of growing mixed and variable catches of wild juveniles. The skill of the current team of senior researchers at the Coastal Aquaculture Centre in developing technologies to breed fish species influences this assessment markedly. **Recommendation: ICLARM staff compare the long-term costs and technicalities of village communities catching and growing mixed catches of larval and juvenile aquarium fish with those of breeding one or two species which are grown out by village people.**

vi) Prawns/Others

Recommendation 14

While the aquaculture of crustaceans, predominantly Penaeid prawns, is currently largely controlled by relatively wealthy individuals, normally with external financing, such aquaculture may have more involvement from village communities in future years. Prawn farming may also develop to be of major economic significance to countries and therefore justify more attention from the Coastal Aquaculture Centre in its role of supporting the region. **Recommendation: the current policy of maintaining a watching brief on prawn farming and encouraging co-operative projects with the farmers involved on issues of mutual interest, for example the grow-out of sea cucumbers in prawn ponds, should be maintained.**

IDENTIFICATION OF ADDITIONAL RESEARCH AND DEVELOPMENT SUPPORT FOR THE CAC

Recommendation 7

The continuation of current research and extension of results on clam and pearl farming into village communities should be high priority. To go hand-in-hand with this there must be the economic and business-oriented research identified above. Significant funding is required if these projects are to lead to realisation of the full benefits from past research. ESCAP has already demonstrated its willingness to provide some support for market research and should be encouraged to continue, and hopefully expand, this support. The review team believes that the European Union would be an appropriate partner for the large-scale regional adoption of the research outputs so far achieved and anticipated in the next few years. Because of the need to extend these results to countries additional to the Solomon Islands this development is truly regional in nature. The review team believes that because of this primary regional emphasis and the extension nature of the work, the SPC should play the leading role. From discussions already held with representatives of the European Union the review team believes that a quality proposal for the appropriate funding would be welcomed by the EU and would have a very high chance of support from their regional funds. As with all funding arrangements timing is critical and the development of this proposal should be regarded as of the highest priority. **Recommendation: ICLARM and/or ACIAR prepare terms of reference for research projects pertaining to village level business plans, and analysis of potential markets; and identify potential funding sources. SPC, with ICLARM support, formally approach the European Union seeking support for the "Proposal to Continue the Development of Aquaculture in the Pacific". (See also Recommendation 17.)**

Recommendation 8

The review team is aware of ICLARM's needs for additional funding to enable the Coastal Aquaculture Centre to continue to develop. We are impressed with what ICLARM has achieved with assistance from external sources. ACIAR's contribution has been fundamental to that success. We also noted the successful input from the Japanese OFCF project into green snail mariculture to the overall operation of the Coastal Aquaculture Centre, but note that the nominal expiry date for this project will soon be reached, before the proposed work has been completed. The very positive benefits to the Centre, and particularly the sea cucumber project, through co-operation with OFCF confirm that every effort should be made to extend the period of this co-operation on this project. We understand that negotiations to extend the green snail work for a further two years are underway. This extension is strongly supported. **Recommendation: Negotiations be undertaken to pursue the extension of the OFCF green snail project for a further period of at least two years.**

Recommendation 9

Improving hatchery and grow-out technology for groupers appears to be a tractable problem. Success would be greatly enhanced by involving individual scientists and laboratories with a proven record in developing technology for the breeding and growing of juveniles of new species. A possibility for supporting this work might be to encourage Japan's OFCF to enter a new period of involvement with the Coastal Aquaculture Centre by jointly sponsoring grouper research. Japan's long involvement in the aquaculture of similar types of fish plus its interest in

similar species and in the development of new technologies may well provide the encouragement OFCF needs to commit to a significant new venture at the Coastal Aquaculture Centre. ICLARM would need to ensure it has adequate and appropriate senior research staff to supervise and support additional projects, as discussed below. However assuming this prerequisite can be met:

Recommendation: ICLARM pursue a new commitment from OFCF to the Coastal Aquaculture Centre for finfish research.

Recommendation 10

Regardless of the specific directions of individual research projects undertaken at the Coastal Aquaculture Centre the review team strongly endorses the need for ICLARM, or other appropriate supporting agencies, to commit to an increase in the long-term staff attached to the Centre. The only permanent ICLARM employee at the senior research level currently attached to the Centre is Dr Bell. Dr Battaglione is currently employed under an ACIAR project grant and his services will terminate in approximately two years. It is appreciated that project funding will probably be required to support most of the future employees based at the Centre, but it is also suggested that the chances of obtaining additional support and of operating the Centre to the international standard that is so essential to its future would be greatly enhanced by the appointment of a second permanent ICLARM research staff member.

Consideration of future employment at the Coastal Aquaculture Centre is further endorsed by the problems relating to the potential departure of both Dr Bell and Dr Battaglione over a relatively short period of time. According to their current professional aspirations and family commitments both of these highly skilled individuals propose to terminate their employment at the Coastal Aquaculture Centre in approximately 2 to 3 years. Departure of both of them within a relatively short period of time could have disastrous consequences for the continuity of projects and the quality of output from the Centre. ICLARM is strongly encouraged to develop a succession plan for both of these officers. If at all possible this plan should include the provision of the recruitment of a third senior scientist to ensure that the mixture of biological expertise, fund raising abilities, administrative skills and technical competence is maintained at all times.

Recommendation: ICLARM develop a succession plan for its senior research staff, including if possible, the appointment of a third senior scientist.

Recommendation 11

We have already noted the considerable, and improving, expertise of the numerous national fisheries officers. We were also most impressed by the value of the February workshop in Honiara for identifying aquaculture research and information needs within the region. ACIAR, ICLARM and the SPC have excellent records in using such gatherings to identify regional priorities and focus potential inputs. **Recommendation 11: Regional meetings of senior national fisheries officers with expertise in aquaculture continue to be used to help identify development initiatives and areas for new research. The SPC appears to be the appropriate body to co-ordinate such meetings.**

EXISTING & FUTURE REGIONAL ARRANGEMENTS FOR AQUACULTURE R & D

Recommendation 15

At the workshop conducted during the review team's visit to Solomon Islands, several other species or species groups were identified as being of high priority for aquaculture research within the Pacific Island region. These included tropical abalone, milkfish, winged oysters, tilapia and marine algae. No detailed information was provided on these species (groups) and the review team cannot confidently suggest priorities. It has already been noted that one of the roles of the Coastal Aquaculture Centre is to identify new potentials for future research. The review team has confidence in the current staff to pursue this task in co-operation with national fisheries officers on an on-going basis.

It is noted that work relating to several of the above species has been undertaken by the FAO South Pacific Aquaculture Development Project (SPADP). As SPADP is scheduled for completion in 1999 it is timely for ACIAR and ICLARM to review progress on these projects and decide on possible sponsorship for those of highest priority which fit well with SPC and ICLARM mandates and expertise. **Recommendation: ICLARM, in consultation with SPC, assess which of the projects currently undertaken through the FAO SPADP, should be continued by either ICLARM or SPC after the cessation of SPADP in 1999.**

Recommendation 16

The review team was given the opportunity to review the draft document entitled "Proposal to Continue the Development of Aquaculture in the Pacific" and to discuss its implications with ICLARM and ACIAR staff and the senior fisheries officers from throughout the region who attended the February Honiara Workshop. We are impressed with the quality of the proposal and its thoughtful and thorough approach to the major issues facing the region. The objectives of the proposed union between SPC and ICLARM (page 13) are appropriate and the respective roles of ICLARM and SPC (pages 14-16) are well defined. The past successes of both organisations in the disciplines prescribed and their strong records in the South Pacific leave little doubt that they are the logical bodies to foster aquaculture research and development in the region. The proposal is strongly supported. It is noted that the role of marketing of aquaculture products is proposed for other organisations (point 7 on page 13). The need for ICLARM in particular, to concentrate on research, rather than marketing, has already been noted in 3 (iii).

The review team noted that ICLARM has to date played the dominant role in the preparation and promotion of the draft proposal. While Dr Bell is to be complimented for the excellence of his contribution, we believe it is now time for the SPC to become the lead agency in progressing future implementation. **Recommendation: The SPC take the lead in promoting the "Proposal to Continue the Development of Aquaculture in the Pacific" and actively pursue funding.**

Recommendation 17

The need for more postgraduate education is apparent and is acknowledged by the senior fisheries officers interviewed during this review to be one of the region's greatest priorities (see section 3 (i)). Universities, such as USP, have a responsibility to offer appropriate infrastructure and intellectual support for such students. National governments and foreign aid donors have a

very large part to play by the provision of scholarships for postgraduate education. ICLARM, and perhaps to a lesser degree the SPC, have a vital role in helping to identify research projects, offering access to facilities, providing mentoring and joint supervision, and perhaps most importantly for scholarships tenable at universities outside the region, in helping to keep projects and interpretations of results relevant to the realistic aspirations of Pacific island people.

Recommendation: ICLARM, USP and SPC develop a Memorandum of Understanding to cover co-operation in the delivery of post-graduate education in aquaculture in the Pacific Islands region.

GENERAL

Recommendation 18

The review team is aware of numerous funding mechanisms ACIAR uses for different types of projects and understands ICLARM's need to tailor applications to accommodate specific requirements of donors. However, we believe both organisations would benefit from adoption of more rigorous project descriptions. Many models of project documents exist and several may meet ACIAR and ICLARM's needs. Those which employ concise guidelines for objectives, anticipated outcomes, milestones and budget justification would be preferable. We recommend ACIAR and ICLARM consider the model used by the Australian Fisheries Research and Development Corporation. **Recommendation: ACIAR and ICLARM adopt a consistent format for project descriptions and give particular emphasis to precise definition of objectives and milestones.**

**List of participants to the ACIAR-ICLARM review workshop of Research on the Culture
of Commercially Important Coral Reef Invertebrates in the Pacific Island Region
17—19 February 1998**

Dr Johann Bell (ICLARM, Solomon Is)

Mr P Gardiner (ICLARM, Manila, Philippines)

Dr S Battaglente (ICLARM, Solomon Is)

Mr B R Smith (ACIAR, Sydney, Australia)

Dr P Lal (ACIAR, Canberra, Australia)

Dr T Adams (SPC, Noumea, New Caledonia) – unable to attend, written comments submitted.

Prof R E Kearney (University of Canberra, Australia)

Prof T Hundloe (University of Queensland, Australia)

Mr E Ledua (Fisheries Division, Fiji)

Mr Ulungamanu Fa'anunu (Ministry of Fisheries, Tonga)

Mr Lui Bell (FAO, Samoa) – unable to attend, written comments submitted.

Mr Sylvester Diake (Fisheries Division, Solomon Is)

Ms Ursula Kolkolo (National Fisheries Authority, PNG)

Mr Moses Amos (Dept of Fisheries, Vanuatu)

Ms Suzanna Gina (AusAID, Solomon Is)

