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MARINE AND FISHERIES

SECTOR STRATEGY STUDY

SUB SECTOR STRATEGY REVIEW

MARINE AND COASTAL RESOURCES MANAGEMENT

(MFSSS Technical Report No. 2)

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EXECUTIVE SUMMARY

On 24 October 2005, Uniconsult International Limited (UCIL) commenced the implementation, in Indonesia, of the Asian Development Bank (ADB) financed technical assistance project "Marine and Fisheries Sector Strategy Study" ADB TA No. 4551-INO. The Ministry of Marine Affairs and Fisheries (MMAF) is the executing agency (EA). The purpose of the study is to develop and formulate a medium to long term (5-10 year) strategy for the marine and fisheries sector within the framework of the National Development Program.

The marine and coastal resources component of the project provides a comprehensive review and assessment of marine and coastal resources problems and opportunities in the sector, and develops a strategy with recommend interventions.

The work of the marine and coastal resources component comprised review and assessment of: (i) the status of the coastal and marine resources and the degree and manner of resource exploitation and a determination of available potential for the capture fisheries production; (ii) relevant international initiatives and programs for marine and fisheries development and management which might introduce innovative marine and fisheries programs suitable for Indonesia; and (iii) the impacts of completed and ongoing marine and coastal resources programs, in order to extract lessons learned to assist future project preparation and (iv) to prepare a medium- to long-term strategy with a holistic approach and innovative measures for marine and fisheries sector development.

Although its mandate is broader, the primary role of the Ministry of Marine Affairs and Fisheries (MMAF) appears to be the management of Indonesia's fisheries, including marine, fresh and brackish-water fisheries, as well as aquaculture. These tasks include research, fishery management, ports, fishing vessels, business and investment issues, aquaculture infrastructure, hatcheries and fish health, fish processing and marketing (including fish product standards), as well as the monitoring and control of fishing activities.

The present MMAF priority is the development of strategies for sustainable exploitation of marine and coastal resources coupled with the necessary protection of the coastal environment. Progress in these areas will contribute to poverty alleviation.

The MMAF has substantial potential to grow and to further contribute to the country's overall development, in particular if it is able to cope with current issues and problems.

These issues are considered in this report and recommendations are presented for strategy proposals for 9 key issues.

SUMMARY OF KEY ISSUES AND RECOMMENDATIONS

Issue 1: Fisheries management failure and over-fishing

This issue is to a great extent related to the difficulty of managing and coordinating Indonesia's large and diverse fishery and marine resources. There is a need for:

(i) Improved systems for making management decisions. Such systems are not just committees, commissions, or working groups, but rather are composed of *sets of policies*. Such policies should be *agreed in advance* and should come into play automatically when certain management situations arise.

(ii) approaches to establish such pre-set policies and related "automatic" triggers, and resultant policy determined actions. These should be developed within the context of management plans, and should be part of the operational aspects of any plans.

(iii) development of mechanisms to actually manage selected fisheries, and other resources, using predetermined policies, in cooperation with resource users and other stakeholders. This activity should include: selection of target resources, setting management goals, setting of policy framework and institutions, setting research priorities, carrying out needed research, *determination of policies and triggers*, establishment of monitoring programs, implementation of management. This could be done in conjunction with the development, and funding, of example management plans.

Issue 2: Lessons learned from Indonesia's fisheries management plans

There have been experiments in fisheries management planning in Indonesia since 1999, i.e. for Bali Strait sardine, the Java Sea small pelagic fisheries, and some other areas (Dompu, Serang, Central Tapanuli, Sangihe, Bantaeng and Muna). These efforts should be continued, taking into account some useful lessons learned. These include: (i) improved understanding of what a fishery management (plan) actually is; (ii) improved coordination between central-, local government and stakeholders; (iii) minimization of an ad-hoc ("project") approach management in favor of comprehensive long-term, sustainable approaches ; (iv) more emphasis on clearly defined fisheries (such as shrimp, e.g. Cilacap, Arafura Sea, Bali Straits sardine, Java Sea purse seine) as opposed to management based on political boundaries. Other possible targets for management plan: Inshore demersal fisheries (small-scale gear), offshore demersal fisheries (bottom gill, net traps), pelagic large mesh gillnet:, inshore seines and liftnets.

Funding requirements for such management approaches must be clear from the start. Ideally projects would provide salaries and a modest budget to create a management plans for selected fisheries. These should be long-term programs (e.g. 5 to 10 years) and should include staffing of, *and legal authority for*, a management body to implement a plan for each specified fishery. These projects should pre-specify *specific performance measures* for successful management. Salaries could be partially dependent on performance of the fishery, not on sales of licenses. Performance might be based, for example on externally monitored spawning stock biomass, and nearness to targets for fishing fleet size and fleet composition, and catch levels. Taxes on landings, and profits from related fishing industries, could be used, later, to fund these management systems.

Issue 3: Gaps in linking resource assessment and management

In the past, outcomes from resource assessments have not been optimally used for marine resource management. This has been mostly due to institutional and coordinative issues, including: (i) lack of clarity regarding the purpose and sources of research funding and (ii) the difficulty of coordinating the several institutions involved in resource assessments (BRKP, other MMAF DGs, LAPAN, universities). Improved coordination is essential in order to: (i) properly review the assessment of these various resources; (ii) design a comprehensive plan for future assessments; (iii)

clearly define the respective roles of these research institutions, (iv) to cooperatively arrange realistic budgeting scenarios so that each individual institution's activities can be funded in a helpful and coordinated manner.

Training programs, and parallel development of programs for higher education, are needed. These should focus on alternate views of fishery management that incorporate concepts of ecosystem based management, the role of protected areas, the consideration of climate fluctuations, and interspecies relationships. These should improve existing programs to develop the broader perspective of fisheries as an activity imbedded within larger ecological- socio-economic systems. Such programs might include system dynamics modeling and ecosystem modeling as well as other approaches. Improving science for management will also be the key for these activities.

There should be a better support for all Indonesian scientists (at government agencies, universities and the non-governmental / private sector) to access and use information resources. This support should include improvement of computer communications and web access from all offices, and training in such technologies where appropriate. This support should also improve links among marine resource workers in different ministries, local government, and the private sector.

Issue 4: Fishery data insufficiency and unreliability

Continued revitalization of the fishery statistics system is needed, especially taking into account changes, and funding issues, created by decentralization. There should also be improved on-board observer, and special sampling, programs. Implementation, and funding for, a regular program of intensive data collection and research programs for key fisheries would be helpful. This could take the form of a special team of data collection specialists who would be assigned to formulate and carry out needed supplemental data collection programs. However, because of the need for long term fishery data, this should not be done at the expense of , or to duplicate, the fishery statistical system.

Issue 5; Using decentralization and co-management to improve fishery management

Decentralization has created significant challenges for fishery management. The coordination of national, provincial and district management has been difficult, and fisheries have suffered. How can we develop the potential of decentralized fishery management at the national, provincial, district, and community level?

Obviously, clarification is needed for the roles of different levels of government as well as for communities/stakeholders. Support for these different roles within a new management paradigm is needed. For example, some "national" resources, such as tuna and other trans-provincial migratory species (small pelagics and shrimps) should be nationally managed (or even internationally managed in the case of highly migratory tunas). But other resources are more realistically managed at a local level.

There is a serious need to move away from the *structural* command and control view of the past to a new system where each level of government improves the *functional* aspects the services it provides to the country and community. Emphasis should be on the provision of services and the *quality* of those services. From a resource management perspective these services should 1) improve the knowledge of resources, 2) help develop management approaches for those resources, and 3) help implement that management.

There is also a need to improve institutional professionalism at district and provincial levels. A reexamination of the professional requirements at the district and provincial fishery offices is needed in light of the additional technical responsibilities devolved to those offices. Professional staff need to be recruited there, and in time, professional staffing at the national level may be reduced.

Issue 6: Implementation of ecosystem based approaches and the development of methods of evaluating these.

Ecosystem based management should be a basis of fishery management planning. Efforts can start with: 1) the gradual switchover to less damaging fishing gear, 2) the development and use of more selective fishing gear, 3) the development of

ecosystem criteria for management of key fisheries, and 4) the consideration of species interactions (e.g. predator – prey) in management.

Issue 7: Linking marine protected areas (MPAs) to fisheries management

Establishment of marine reserves for fishery purposes. Creation of these reserves could start the establishment of "special management areas" where enforcement of more restrictive fishing rules applies. These could ultimately be designated as marine reserves in the future. Marine reserves should be seen as a part of an overall fishery management strategy. A program should be established to identify and prioritize key areas as marine reserves, including seasonally closed areas, and restricted fishing areas, for each fishery management area.

Issue 8: Insufficient account for natural fluctuations when managing marine resources

There is a requirement for incorporation of the reality of natural fluctuations into fishery management and planning paradigms. Some works had been started (e.g. Bali Strait sardine and West Nusatenggara squid fisheries), but the models produced need to be tested for use in management. This should involve a great deal of work including a precautionary response when stock assessment reports are favorable. This approach should strive to avoid over capitalization in fishery related activities when stock increases may be only temporary.

Issue 9: "Community"-based, co-management issue

There have been limited success stories of true community involvement in fishery management – and most of them are traditional practice such as *sasi.* The so-called community-based fisheries management introduced by some projects in the past have been mostly on an ad-hoc, project basis although these have been very helpful.

There is a need to develop nested management systems, incorporated into fishery management planning and law, whereby clear roles for national, provincial, district and local stakeholders are defined. Rights and responsibilities of all stakeholders

and resource participants need to be clarified. Also needed is a means of extend the usefulness of co-management of key resources beyond the fixed area approach. Means of defining all stakeholders, and other management participants need to be developed for the Indonesian situation. Full participation of all stakeholders in developing realistic, successful, co-management programs is one of the major challenges, and opportunities, of decentralization. Techniques are also needed to develop, and improve, locally based management systems, including traditional ones, and local participation in larger management systems, without creating unnecessary dependence on various levels of government and external funding. The long term goal is to have community based components truly local, and supported, and funded, by the fishery participants including dependent businesses.

ACRONYMS & ABBREVIATIONS

ADB	Asian Development Bank
CCRF	Code of Conduct for Responsible Fisheries
COFISH	Coastal Community Development & Fisheries Resource Management Project
COREMAP	Coral Reef Rehabilitation and Management Program
CRMP	Coastal Resources Management Project
DAK	Special Budget Allocation Funds (initials in Bahasa Indonesia)
DG	Directorate General/ Director General
EA	Executing Agency
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
BRKP	Badan Riset Kelautan dan Perikanan (Marine and Fisheries Research Agency)
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
GOI	Government of Indonesia
GT	Gross Tonnes
KOMNAS KAJISKAN	Komisi Nasional Pengkajian Sumberdaya Ikan (National Committee For Fish Stock Assessment)
KOMNAS KOLAUT	Komisi Nasional Konservasi Laut (National Commission on Marine Conservation)
LIPI	Lembaga Ilmu Pengetahuan Indonesia (Indonesian Institute of Sciences)
MAREMAP	Marine Resources Evaluation Management and Planning Project
MCRMP	Marine & Coastal Resource Management Project
MCS	Monitoring, Control and Surveillance
MREP	Marine Resources Evaluation and Planning Project
MMAF	Ministry of Marine Affairs and Fisheries, or DKP in Indonesian term.
MPA	Marine Protected Area
NGO	Non Governmental Organisation
NMTDP	National Medium Term Development Plan
PERDA	Peraturan Daerah (local regulation)
PT	Perseroan Terbatas
P20	Pusat Penelitian dan Pengembangan Oceanologi (LIPI's Centre for Oceanological Research and development)
UCIL	Uniconsult International Limited
UNESCO	United Nations Educational, Scientific and Cultural Organisation
USAID	United States Agency for International Development

1 ROLE OF GOVERNMENT IN ASSESSMENT AND MANAGEMENT OF MARINE AND FISHERY RESOURCES

1.1 Role of the Ministry of Marine Affairs and Fisheries in the Management of Marine Resources

1.1.1 Fisheries resources

Although its mandate is broader, the primary role of the Ministry appears to be the management of Indonesia's fisheries, including marine, fresh and brackish-water fisheries, as well as aquaculture. These tasks include research, fishery management, ports, fishing vessels, business and investment issues, aquacultural infrastructure, hatcheries and fish health, fish processing and marketing (including fish product standards), as well as the monitoring and control of fishing activities. One section of the ministry, the Directorate General for Marine Affairs, Coastal Areas and Small Islands, has a slightly different role which includes coastal zone planning, marine protected areas, as well as island and community empowerment. At the director general level, a recently established agency for human resources development, includes the vital marine and fisheries extension service.

Although many issues determine the exact role of the ministry, the legislation most affecting its current role is law number 31 of 2004 concerning fisheries. This law, among other things defines "fishery management" for the first time, and sets out the requirement for fishery management areas and fishery management plans. It specifically states the responsibility of the Minister in allocating catches based not only on fisheries potential, but also on conservation and sustainability.

This national role in managing marine resources is, nevertheless, complicated by the role of local government in resource management, a role that was significantly strengthened by law 22 of 1999, and further clarified by law 32 of 2004 regarding regional administration. These laws specifically refer to the administration of near-shore areas by provinces and districts (to 12 and 4 miles respectively) and states the responsibility for conservation, as well as the utilization, of resources. Revenues derived from these resources are to be shared between regional and national government. While the legal aspects of these arrangements are covered in other parts of these reports, the fact remains that, in spite of the clarification provided by

these laws, practical aspects of marine resource management have been seriously complicated by decentralization.

1.1.2 Other living marine and coastal resources

The exact nature of the Ministry of Marine Affairs and Fisheries' role in the management of non-fishery marine resources is still in flux. Within the ministry there is a strong concern and desire for good management of non-fishery resources. However, from a practical perspective, there appears the growing realization that other ministries will likely have a leading role in the management of some of these resources, especially non-living resources. In reality there is currently little expertise, or political influence, within the Ministry to be involved with such things as undersea mineral exploration, marine tourism, or marine transport because most of these issues are already covered by "marine" branches of other ministries. Also, there is no structure within the ministry for these areas. Ultimately, any new emphasis in these other marine issues is a policy decision to be made in the higher levels of government.

Nevertheless, the ministry of marine affairs and fisheries *does* have a strong interest, and expertise, in the management of *living* marine and coastal resources such as mangroves, coral reefs and associated flora and fauna. This interest and responsibility extends into coastal areas where human impacts have a significant impact on natural ecosystems, and where humans are strongly dependent on marine and coastal resources. In this regard the ministry coordinates closely with the Ministry of Forestry's Directorate of Forest Protection and Nature Conservation. Nevertheless, the Ministry of Marine Affairs and Fisheries' responsibilities extend well beyond "protection" and include the much more difficult realm of careful management, sustainable utilization, and regional planning. For other comments related to non-fishery resources see section 2.6.

In addition to the laws on fisheries, and those on decentralization, A pending national law concerning management of coastal resources, and a draft national ocean policy will also affect the roles and responsibilities of the various ministries. For a more complete listing of legislation related to marine resource management see the report related to these legal issues.

Because of the importance of marine and coastal resources to the nation, the government has, in the past, undertaken numerous projects in cooperation with bi-lateral and international donors related to these issues.

1.2 Relationship to other national level agencies

The coordination of activities related to marine and fishery resources, particularly living resources, requires the careful attention of three ministries in addition to the Ministry of Marine Affairs and Fisheries. These are the Ministries of Forestry, the Ministry of Environment and the Ministry of Culture and Tourism.

While the Ministry of Culture and Tourism is relatively new, it has strong influence politically, because tourism has become a major contributor to the national economy. The Ministry of Forestry has a long history of managing natural resources including marine protected areas and protected species, the Ministry of Environment is relatively new and weak compared to other ministries. This is unfortunate. Marine, and other, pollution problems are becoming more and more severe. This is a key area of concern that has been overlooked during Indonesia's economic development. Better support for pollution abatement, and cleanup, and the development of strict environmental regulations are essential for the full realization of Indonesia's marine potential. Without this improvement the abundance of marine resources will decline, and food from the sea will become unsafe (see also the project report covering this subject: Currie 2006).

The close coordination of marine and fisheries research among Indonesia's research institutions is also essential. The Ministry of Marine Affairs and Fisheries houses several well established research institutions and these have a good working relationship with the Indonesian Institute of Sciences (*Lembaga Ilmu Pengetahuan Indonesia - LIPI*) -- especially the oceanology division (*Pusat Penelitian & Pengembangan Oseanologi, P2O LIPI*). There are also regional research institutions, including both governmental bodies (i.e. *Badan Penelitian & Pengembangan Daerah* - Provincial R&D) as well as trans-sectoral, semi-independent units (i.e *Dewan Riset Daerah* – Provincial Research Council), which in reality have not yet been included in cooperative programs. Nevertheless, such cooperation, as well as cooperation with universities, should be encouraged as integral components supporting the continued development of the research programs of the ministry.

1.3 Decentralization of resource management

1.3.1 Background

During the last few decades, until the late 1990s, there were only gradual changes in the balance of power between the provinces and the central government. Governors and district chiefs were appointed by the president, and most rules and regulations, including those related to marine resources and fisheries, were derived from central authority. Some feel that this centralized approach, and related "nationalization" of resources was a primary cause of the overexploitation of fisheries which occurred (Satria and Matsuda 2004). This argument assumes that centralized management costs are unrealistically high, that such management was unable to incorporate positive forces of local control and enforcement, and that industrialization of fisheries occurred in a way that ignored local concerns. This process may have devalued traditional management systems which had existed in parts of Indonesia. This is, perhaps, an exaggerated view. Other views assume that the centralized system resulted from post-colonial socialist ideals as promoted within the non-aligned movement, that centralization is a cultural norm of Indonesian/Javanese culture, or that centralization was merely a means for powerful people to exert control over exploitation of valuable resources.

Regardless of the reasons for centralized system that came into existence, calls for increased regional and local control of resources started in earnest in the late 1990s. With the departure of President Soeharto in 1998 things changed rapidly and the passage of 1999 law 22 regarding regional governance marked the first legal step toward real local control of resources. Unfortunately, under current reform, this law, though popular with districts, led to a lot of confusion. Few guidelines were provided, and districts, for the most part unprepared for this change, struggled to write appropriate local regulations, including those governing exploitation of marine and fishery resources.

The local – central shared control of natural resources was further clarified by two important 2004 laws, law 31 concerning fisheries and law 32 regarding regional administration.

Although better in theory than centralized control, decentralization created its own special set of problems. Community based management is appropriate under certain conditions, but it is no panacea. In any case, local government management does

not always respect the role of communities. Not all fisheries are based on local resources, and the removal of national authority complicates management of resources shared among districts and provinces.

Nevertheless, the role of local management is vitally important, and carefully crafted local management regimes can be assembled into a national network for marine resources management, if supplemental national legislation, and regulation, provide the framework. In any case this local – regional mix of authority is now the *de-facto* setting for marine resource management.

1.3.2 Actual role of provincial and district governments

1.3.2.1 Local legislation (Peraturaan Daerah – Perda)

In theory, following law 22 of 1999 regarding regional governance, every district had to develop local regulations governing resource management and exploitation. Some district were already formulating such regulations prior to 1999. Also, some districts had instituted local regulations through interpretation of earlier legislation related to spatial planning (Law 32 of 1992) (see Purwaka and Sunoto 2001). Also, many small changes had occurred over the years which gradually gave control of marine resources to districts and provinces (Satria and Matsuda 2004). Nevertheless, by late 1999 all districts were struggling to create comprehensive local regulations.

While some districts had assistance from externally funded projects which were underway at the time (e.g. the USAID coastal resources management project: North Sulewesi, Lampung, East Kalimantan) (see Hanson et al. 2003) and other districts had additional assistance provided through subsequent projects (e.g. the ADB marine and coastal resources management project) most districts prepared local regulations without external assistance.

Because local regulations were created at both the provincial and district level there is potentially a wide variation in the details of these laws and regulations, and a significant possibility of potential conflict with those issued by the central government. The exact nature and extent of these real, and imagined conflicts, are an ongoing source of confusion which significantly hampers careful management of marine resources.

1.3.2.2 Local management / Traditional management / Fishery management "plans"

In addition to national and local regulation, there are a number of traditional management systems in parts of Indonesia, such as *Sasi* in Maluku and Irian, and *Awiq-awiq* in West Nusatenggara and Bali. Some of these have been incorporated into local regulation. Also, there is now a requirement, from law 31 of 2004 regarding fisheries, that fishery management plans be developed. International, as well as Indonesian, interest in community based management presents an opportunity for traditional systems to form a part of community based fishery management plans, but several problems may hamper this development. Further discussion of these issues is provided in section 3.7.1.1.

1.4 Marine protected areas and their relation to fishery management

In recent years considerable effort has been put into the improved management of coastal areas with special emphasis on marine protected areas, including national parks in coral reef areas. These efforts, supported by a number of projects, have also emphasized community based resource management. These approaches have been fairly successful because of: a) large amounts of external funding, and b) the appropriateness of the community based approach for what are largely place-based resources. That is, these resources, typically coral reef or mangrove areas, are largely non-migratory, near shore, and easily identified with a particular location.

Although these efforts are directed toward improved management of marine protected areas, their potential contribution to improved fishery management is also important. Although marine protected areas cannot solve all fishery management problems, they can significantly contribute to better management (e.g. see Mous et al. 2005). Thus marine protected areas should be incorporated into any fisheries management system. See further discussion in section 3.6.3.

2 CURRENT APPROACHES FOR RESOURCE ASSESSMENT AND MANAGEMENT

2.1 Overview

Indonesia's fishery management is, in theory, carried out in 9 management areas. Within each area stock assessments are carried out by research personnel (of the MMAF Research Agency and Fish Capture Development Centres) and the results, combined with data from other sources, used to develop recommendations that are passed up to the minister's office for action. These are then passed on to the DG for capture fisheries where, in theory, appropriate action is formulated.

Within this process there are a number of problem areas which the ministry has been working hard to minimize. These problem areas, discussed below, can be summarized as follows:

1) difficulties in obtaining accurate statistical and biological information regarding the fisheries and other resources,

2) use of limited data then restricts stock analysis to relatively simple approaches which may not be appropriate for particular fisheries.

3) a certain lack of understanding within management agencies regarding the meaning of the analysis, particularly the incorrect idea that sustainable yield is a target that can be reached only by fishing more intensively. This misperception can lead to inappropriate recommendations.

4) apparent limitations on administrative and legal ability to create or legislate management actions that can help control a fishery.

5) the difficulty of multiple management and licensing agencies (national, provincial, local), the fact that boats so licensed can fish within the same fishery, and the fact that smaller boats do not need licenses.

6) the need for a multitude of enabling decision letters, or regulations, to activate the relatively new fishery, decentralization and (pending) coastal area legislation.

2.2 Research for management

2.2.1 Background

Most fish stock assessment activities are carried out by the Research Center for Capture Fisheries, within the Agency for Marine and Fisheries Research. Some of this information, in summary form, is presented at an annual forum for assessment of marine fish stocks (e.g. Widodo et al. 2003). The latest forum (still unpublished) was held in December 2005. Each annual forum provides summaries of research findings for a selection (usually 3) of the 9 fishery management areas. Much of this research is unpublished, or is available in internal reports with very limited distribution.

For each fishery management area, information is summarized for several fishery types, usually: large pelagic, small pelagic, demersal fishes, shrimp, squid and cuttlefish, coral fish for consumption, and ornamental fish (See section 2.5). The latest (2005) forum also presented some findings on deep sea resources. Often only some fishery types are analyzed for a given management area. Additional information, such as oceanographic data is sometimes provided.

Reportedly, the Research Center for Capture Fisheries focuses on three of the fishery management areas for a period of two years, and then switches to a different set of areas. Thus, under present procedures most stock assessment research focuses on 3 of the 9 management areas for a two year period.

Most assessments of Indonesian fish stocks are made on the basis of surplus production models supplemented by, in the case of demersal and small pelagic fisheries, limited acoustic surveys. Both techniques provide fairly gross, but useful, estimates of stock biomass. This stock size information is often supplemented with basic biological data.

The surplus production approach relies heavily on fishery data including catch per unit effort information, which, in theory, is “easy” to obtain. This raises a special concern since there is evidence that the decentralization process has weakened the fishery statistics system, further complicating the acquisition of good fishery statistical data.

Hydro-acoustic surveys, coupled with trawl and pelagic net surveys, require expensive research cruises, so such cruise data is somewhat limited. There is also

some research activity making use of satellite derived oceanographic data supplemented with oceanographic cruise data. This information can supplement fish stock information and help to determine causes of fish stock fluctuations (e.g. such as those caused by El Niño). Some of this supporting research is carried out by research branches of the ministry such as the South East Asia Center for Oceanographic Research and Monitoring. Other entities also carry out related research including the Indonesian Institute of Science's Oceanological Center and several universities.

Research tends to focus on determination of the maximum sustained yield (MSY) for each fishery grouping for a given fishery management area. Assessments of MSY have also been attempted by provincial and district governments, since under local autonomy they are forced to present MSYs for all the species groups that exist in their coasts and seas. This has been very misleading because their reports also include MSYs for migratory species (e.g. tuna and some small pelagics). Basically, for many situations, MSYs make little or no sense on a very localized level.

Previously the MSY was viewed as the maximum potential catch of the area. In recent years, however, the *allowable catch* for each fishery group has been changed to 80% of the calculated maximum sustained yield. (Comments on these approaches are in section 3.2)

2.3 Decision-making, responsibility, and flow of information

One major problem area for marine resource management in Indonesia is the failure of the decision making process and the consequent lack of meaningful resource management action. While the most visible problem area is enforcement, this failure is really due to a *lack of effective resource management processes at all levels*.

General goals for resource management are well established, but means of translating these into practical management policies and actions seems weak. In other words, there is a failure to envision the practical ramifications of established goals, and to implement actions needed to attain those goals.

Nevertheless, during the past few years, following the UN/FAO Code of Conduct for Responsible Fisheries, fisheries management plans have been introduced in some areas / fisheries, such as the Bali Strait sardine, the Java Sea small pelagic fisheries (both supported by FAO), Gulf of Saleh (NTB) fishery, North Coast of Serang

(Banten), Bantaeng (South Sulawesi), Sangihe (North Sulawesi), Muna (South East Sulawesi) and South Tapanuli (North Sumatra) (supported by Japan JSDF/World Bank). However, most of these plans still seem to be in the very early stages of development rather than fully implemented.

Research information, including that derived from fish catch statistics, should used to determine the appropriate levels, and types of fishing for each fishing area. Research findings, after analysis and discussion, are passed on to the directorate for capture fisheries where they should be used to determine types of regulation and number of licenses etc. In other words research findings should be used to regulate the number of vessels, and types of fishing gear in each fishery. Nevertheless, many fisheries are considered over-fished, but gear and licensing restrictions seem of minor importance, partly because implementation is so difficult. This non-use of research findings, and the data on which they are based, has a negative effect on the perceived importance of these data and has degraded the value of research.

Further complicating these difficulties in management is the reality of decentralization, and the fact that only the very largest boats come under the legal control of the central government. For example, although most respondents to our queries felt that provincial and district laws had to "follow" the national laws and regulations, none were certain that this was actually the case. In fact, one informant specifically stated that the national government could only to appeal to the provinces if a decrease in licenses was desired, there is no direct control.

2.3.1 Interagency "management" organizations

Partly as a result of the difficulties faced in attempting to manage resources within a newly decentralized situation, a number of coordinating bodies have been established to assist with this task. Among these are the following:

National commission on stock assessment (Komisi Nasional Pengkajian Sumberdaya Ikan KOMNAS KAJISKAN)

As described above, this commission meets annually to present and discuss results of stock assessment and related research (e.g. see Widodo et al. 2003). According to informants, research efforts, and the forum, focus on 3 of the 9 management areas for 2 years and then moves on to another 3 areas. The most recent meeting was held in December 2005. The commission is now based on ministerial decree 14 of

2005, in accordance with the fisheries law 31 of 2004, but the commission had existed previously, and was merely reformulated under the new law.

National coordination council for fishery resources management and utilization (Forum Koordinasi Pengelolaan dan Pemanfaatan Sumberdaya Ikan)

This national coordinating council meets annually to work out details of fishery management as determined by stock assessments, and other information. Each annual meeting might only involve discussion of some of the 9 fishery management areas. The next meeting of this forum is scheduled for Manado in August 2006.

There are also sub-national coordination meetings held to coordinate management within each fishery management areas. In some cases there are sub-management area meetings as well, involving only one or two provinces, for example. These meetings cover a number of fishery issues including conflicts between fishermen from different areas (as in East Java / Bali), allocation of fish catch, discussion of the need for licensing restrictions. Typically, each district will present an overview of their area, and this will be followed by group discussions of subjects ranging from law enforcement to research findings. Relatively little discussion of stock status takes place at these meetings, although licensing issues may be discussed.

The meetings of this commission and its sub-parts have already taken place in several regions. It has addressed real issues related to decentralization and fishery management. For these reasons it appears that this commission, and its sub-commissions, will likely become important fishery management institutions.

It is possible that in the future this commission will have close arrangements with fishery management plans and their implementation.

National Commission on Marine Conservation (Komisi Nasional Koservasi Laut KOMNAS KOLAUT)

This commission, based on a decision letter of October 2004 from the Director General of Coastal Areas and Small Islands, includes representatives from the Ministry of Marine Affairs and Fisheries, the Ministry of Forestry as well as members from a number of non-governmental organizations. Its function is related to marine conservation issues, including those that may impact the exploitation of marine resources, but it focuses more on protected areas and species.

Indonesia's Fisheries Society (Masyarakat Perikanan Nusantara)

This is a forum to discuss and solve fisheries issues within and related to Indonesia's fisheries development. It was established on 31 May1996 and formally announced by the President of the Republic of Indonesia. The Society is currently chaired by a leading fisheries businessman, and assisted by a secretary who is a statesman (retired senior fisheries officer). Its main goal is to focus fisheries utilization in optimal and sustainable manner toward maximum benefit to the people. This goal is expected to be achieved through: (i) partnerships among stakeholders and government; (ii) involving fisheries communities/stakeholders participation in fisheries development; (iii) contribution in policy formulation for fisheries development; (iv) identification and monitor recent progress in fisheries management and development.

Indonesia's National Maritime Council (Dewan Maritim Nasional)

This is a forum to discuss and solve marine conflicts resulting from overlapping jurisdictions and misunderstandings among ministries, and different levels of government. It reports its recommendations directly to the president. This council was created via a presidential decision (161/1999) in December 1999. It is headed by the Minister of Marine Affairs and Fisheries, on behalf of the President, and includes as members eleven ministries, the navy, plus others. This council is does not appear to be involved with the day to day decisions regarding marine resource management.

Council for the Assessment of National Fishery Development (Dewan Pertimbangan Pembangunan Perikanan Nasional)

This council is specified in the fisheries law (31 of 2004), but does not seem to have been implemented yet.

2.4 Fishery management areas

Fishery management is currently attempted on the basis of 9 fishery management areas. These are the Indonesian waters of the 1) Malacca Straits, 2) South China Sea, 3) Java Sea, 4) Flores Sea and Makkasar Straits, 5) Banda Sea, 6) Arafura Sea, 7) Maluku Sea, 8) Sulewesi Sea and Pacific Ocean, and 9) Indian Ocean. There is a

plan to subdivide the Indian Ocean sector into 2 areas which would be waters west and south of Sumatera to Bali, and Indian Ocean waters farther east.

2.5 Fishery groupings

Within each fishery management area stock assessments are usually made in each for the following species groups.

Large pelagic: As defined in Indonesia this grouping includes larger members of the tuna family, billfishes, and many shark species. Emphasis is on tunas, and usually separate statistics are collected for large tunas (mostly yellowfin and bigeye) which are specifically targeted with long line, and skipjack which are targeted with purse seine and pole and line. Of course these gears catch many other species as do boats using large mesh gillnet. These typically catch a wide variety of large pelagic species. Smaller tunas, including several known as tongkol (including long-tail tuna and kawakawa or eastern little tuna) are sometimes abundant. Note that in the recent past there has been significant participation by Indonesian vessels in the Indian Ocean tuna fishery. In 2003 total tuna landings were 800,000 tons valued at over one billion US$.

Small pelagic: There are a wide variety of small pelagic species in a number of families including, mackerels (Scombridae, the tuna family), scads / jacks (Carangidae), sardines / herrings (Clupleidae), anchovys (Engraulidae) . Some fisheries target specific species (e.g. Bali Straits sardine fishery), but even there some by-catch occurs. Typically these fisheries are moderately multi-species. The important Java Sea fishery purse seine fishery (including boats using similar fishing gear) catch mostly *Decapterus* and *Rastrelliger* species, but the catches include a number of others species.

Demersal (bottom fishes): Even when excluding the next grouping (coral reef species) the extremely diverse demersal fish fauna makes this grouping fairly meaningless for fishery management purposes except in very general terms. This grouping easily includes several hundred species from tens of families. Clearly, data analysis and management approaches are difficult. Fish in this group are caught by gillnet, traps, and increasingly, trawls (which had been banned in much of Indonesia since 1980), including those used to catch shrimp.

Typically under high fishing pressure the species composition of the demersal catch will change as slower maturing and larger species are "fished down". Further discussion of this and related problems is discussed in section 3.6.1.

Management of demersal fishes in a sustainable and eco-friendly manner is a significant challenge for fishery managers.

Shrimp: The fishery for wild-caught shrimp is of major importance in Indonesia. In 2003 Indonesian shrimp landings of about 240,000 tons were worth about US$500 million. Most parts of Indonesia have important shrimp fisheries, but such fisheries are especially important along the coasts surrounding the Java Sea, the Cilacap shelf on the south coast of Java, and the Arafura Sea.

Shrimp aquaculture is now a large industry and cultured shrimp production is of the same order of magnitude as sea-caught shrimp. Destructive shrimp culture techniques, particularly the clearing of mangroves for shrimp ponds, can have a detrimental effect on sea-caught shrimp since some shrimp species use mangroves as nursery areas.

Because of its high value, shrimp is a commodity which should be targeted for improved management, and perhaps certification for some areas. See additional comments under 3.5.1.1.

Coral fishes: Coral reef fisheries provide both subsistence, marketable food products, and ornamental fishes for export. The group is highly diverse, and many species are found only in certain areas, and / or habitats, or have special behavior patterns. This group is associated with a highly diverse marine flora and fauna, including a high diversity of corals. Fishing activity can cause significant direct and indirect damage to these ecosystems. Even the direct harvest of fishes via non damaging methods affects the underlying ecosystem more than in other ecosystem types making the management of these fisheries particularly challenging.

Two special fisheries for live fish are an important component of this fishery. These are the fishery for 1)ornamental fishes, and 2)live reef fish sold to restaurants. The second type is problematical since even juvenile predator species can be captured and raised in cages until they reach a marketable size. This can cause a rapid disappearance of predators from a reef upsetting the ecological "balance".

This fishery grouping is best managed using an ecosystem approach incorporating marine protected areas. Even under that type of management special arrangements will need to accommodate special species by species needs (e.g. the protection of special spawning areas, and spawning aggregations). See further discussion in sections 3.6.3 and 3.6.4.

Squid and cuttlefish: These are in theory a separate grouping for management purposes. However, there does not appear to be any special data collection or stock assessment information for this grouping. Nevertheless, some research has been carried out in selected areas, such as the Alas Strait, West Nusatenggara (Ghofar 1996, 2002, 2005), where monitoring of incidental catches and fishing effort was carried out.

Other Groups: There are some examples of other groups having been targeted for specific management approaches and separate stock assessments. One of these is the sardine which is the primary target of the fishery in the Bali Straits. Also, there is some talk of formulating a management plan for flying fish which has valuable eggs that are harvested. In addition there are several geographic areas targeted for "fishery management plans" (See further discussion in section 3.5.1).

2.6 Non-Fishery Resources

2.6.1 Coral reefs and related resources

One of Indonesia's most important and well known resources, coral reef ecosystems, are the subject of much concern and many ongoing activities. Within the Ministry of Marine Affairs and Fisheries, the agency dealing with these issues is the Directorate for Conservation and National Marine Parks. However, another government agency involved with these issues is the Directorate for Conservation Areas – Sub Directorate for Wetlands and Marine Conservation which comes under the Directorate General of Forest Protection and Nature Conservation, within the Ministry of Forestry. The Directorate General for biodiversity conservation in the same ministry handles issues related to, among other things, endangered species and international conservation agreements. Many of those activities deal with marine protected areas of one sort or another (see section 1.4).

Fishery management within existing marine protected areas is carried out on an ad hoc basis typically with some cooperative arrangement with local people. Many

examples have been developed and funded with external assistance, but traditional management also plays a significant role.

A number of externally funded projects have focused on this area. The ongoing COREMAP projects have received, and continue to receive funding from the Asian Development Bank, the World Bank, and the Government of Australia. A significant part of recent USAID funding was also directed at coastal area management including management of coral reef areas. In addition, substantial parts of International conservation NGO programs (especially The Nature Conservancy and the World Wide Fund for Nature) are directed at coral reef management and protection.

There are *no marine protected areas that are completely closed to fishing activities*. This is because exchange for local cooperation requires that a certain amount of exclusive local resource use rights be permitted.

2.6.2 Mangrove forests

The management of mangroves is the responsibility of the Ministry of Forestry, although the management of fishery resources dependant on those forests is the responsibility of the Ministry of Marine Affairs and Fisheries. Because mangrove forests are primarily the responsibility of the Ministry of Forestry, their status and management problems have not been analyzed here. However, the mangrove forests themselves, and also the particulate carbon that enters the marine ecosystem from them, both play an important role in fisheries. For this reason, the Ministry of Marine Affairs and Fisheries has an interest in ensuring that mangrove forests are well managed.

2.6.3 Biodiversity

Biodiversity is an area of major concern to marine resource managers. Firstly it is a source of value: the variety of organisms which make up natural systems provide, or support, those organisms which are harvested for human use. Secondly biodiversity is potentially harmed by fishing and other resource extraction activity: the act of extracting useable natural resources, if not done carefully, can harm the underlying support system. Thirdly, we expect that a few of the myriad of organisms might hold chemical compounds of use in medicines or other applications. One of the challenges for Indonesia is to develop natural resource management strategies that

will minimize adverse impacts on biodiversity at the ecosystem, population (species) and genetic levels. At the same time Indonesia will wish to sustainably benefit from these organisms.

At present "biodiversity" appears to be viewed as something to be protected, and such protection is typically separated from management. That is, protection is not seen as an integral part of management. Under this paradigm, "biodiversity" is something that needs to be protected partly because international conventions mandate such protection. This is an very narrow view. Protection of biodiversity is also good resource management. In fact, *falling biodiversity is one indicator of poor management*.

Ideally, protection of biodiversity should be accomplished *everywhere* through good management, *not* just in protected areas, *not* just for protected species. Biodiversity protection should be a consequence, and an integral part, of good resource management.

The real challenge then is to incorporate biodiversity protection into every management plan and program (see section 3.6.1).

Of special interest to Indonesian marine resource managers are coral reef fishes. Indonesia is home to more reef fish species than any other country – over 2,000 species (McKenna et al. 2002). Special efforts to protect this biodiversity are warranted, and are underway through the establishment of marine parks and other marine protected areas. These efforts should continue to receive top priority (see section 3.6.3), but at the same time efforts should also be made to better manage biodiversity resources *outside* protected areas.

2.6.4 Species of special concern

There are a number of groups of special concern, and those listed here are representative examples. Work on protected species is coordinated through the Department of forestry agency mentioned above (2.6.1) .

2.6.4.1 Marine Mammals

Marine mammals have a significant presence in Indonesia, and there are significantly impacted by fisheries. There is concern that small whales and other marine mammals are being harvested and accidentally killed through the use of

inappropriate fishing gear. For example, in 1997 several hundred pilot whales and several hundred dolphins were killed in very large set fixed gillnets / traps near Bitung (Rossiter 1997?).

Officially, however, the whale harvest in Indonesia is very small and consists mostly of sperm whales harvested in a traditional fishery based on Lembata and nearby islands. The world population of sperm whales is estimated to be 1 to 2 million, while the Indonesian annual catch is only about 20. Nevertheless, this harvest falls within an International Whaling Commission sanctuary. Even though Indonesia is not a member of the International Whaling Commission, whales are officially fully protected in Indonesia.

Recently a pygmy Bryde's whale, *Balaenoptera edeni* was discovered in the waters of Komodo National park. This is a rare and little understood species. This discovery highlights Indonesia's potential role in increasing our knowledge about these interesting animals.

Dugongs are present throughout much of Indonesia in low numbers and are an officially protected species. About 30 to 40 years ago the dugong population numbered about 10,000, but now only about 1,000 individuals remain, mostly in eastern Indonesia. Dugongs are slow growing and highly vulnerable to exploitation (for more information see Marsh et al. 2002).

Indonesia is a partner in dugong protection efforts as a signatory of the Convention on Migratory Species through the Ministry of Forestry. There is a dugong management plan in preparation.

While issues related to marine mammals are relatively minor compared to other resource management issues, Indonesia should continue its work to improve public awareness of marine mammal issues and particular, should attempt to modify or eliminate fishing activities that adversely affect marine mammals.

2.6.4.2 Turtles

The management and protection of marine turtles, like other protected species, comes under the Forestry Department. Under an international agreement on migratory species, Indonesia has signed an agreement on turtle conservation.

Like other long-lived, late maturing species, marine turtles are very vulnerable to over-harvest. Typically, marine turtles don't reproduce until they reach an age of 30 years. Although these species are officially protected, the harvest of adults and eggs in Indonesia continues, and authorities seem unconcerned about this harvest. The continued disappearance of beach nesting sites is also a major concern.

Surprisingly the harvest of up to 1000 turtles per year is tolerated in Bali because this harvest is considered to be a part of traditional ceremonies. Also, the continued harvest of eggs in many localities is a major threat, and belies an serious misunderstanding of turtle biology. These eggs are from turtles that were hatched over thirty years ago. Now, even the egg collectors are complaining that the eggs are hard to find. Without improvements in management and enforcement we can only conclude that turtle populations in Indonesia will eventually disappear.

There are some well meaning projects which hatch turtle eggs in captivity. The utility of this approach, unless absolutely necessary, has been questioned for a number of reasons. One problem is that the temperature of the nest can alter the sex ratio of turtles.

2.6.4.3 Other

There are a number of other protected marine species, and some are directly affected by fisheries. One interesting example is the humphead wrasse (or Maori or Napoleon wrasse) *Cheilinus undulates*.

This species typifies some of the problems facing management of coral reef species. It grows to a large size but apparently changes sex so that the larger fish are males. Fishing tends to remove these larger individuals from the population. This is a much sought after food fish and, especially when marketed live, commands a high price. Even smaller fish are caught since they can be raised in cages for later sale. For further details see Sadovy *et al.* (2003). This species is a target for aquacultural research working to develop methods of spawning it in captivity. To date these efforts have been unsuccessful.

2.7 Decentralization, local management, and marine resources

Decentralization is a source of difficulty for the management of Indonesia's marine resources. National level agencies, created during the period of highly centralized

government, still exist, and absorb a large portion of the national budget. While budgets are still allocated to the national agencies, qualified staff are fewer at the provincial and district level. Thus, for the practical reasons of limited budget and staff capabilities, provincial and district agencies are not yet comfortable with the role of managing marine resources. While some districts have been successful in overcoming these limitations, the majority are still struggling in their new role as resource managers.

The emerging consensus regarding the probable ultimate role of central and local government appears to include the idea that the central government will continue to carry out resource assessments, and will continue to make recommendations regarding total allowable catch levels for most fisheries. The difficulties lie in creating real limitations on fishing since means of limiting fishing do not lie within any one agency.

Limits on fishing effort are usually attempted via licensing systems. In Indonesia many boats fish without licenses, and some, boats less than 3 gross tons (or less than 5 tons depending on the source of information), can do so legally. Licensing is now carried out at three overlapping levels (national, province, district). This system attempts to separate the *area of fishing* granted by each licensing authority through a zonation system (distance from shore) and by boat size. However, as implemented, the system only prevents larger boats from fishing in areas nearer to shore. It does not prevent over-fishing for several reasons.

Of importance are the following points: 1) boats less than 3 gross tons (or 5 according to some sources) do not require a license, 2) boats less than 30 gross tons can fish in national waters without a national license (although one informant claimed that they *cannot* fish there without a national license). The first factor limits the likelihood that inshore fisheries can be managed carefully and the second limits the fishery management in waters outside 12 miles. These difficulties are conceivably solved within the coordination council set up for that purpose (see Section 2.3.1) but this appears to be an ad-hoc approach.

Also, most fishery resources extend across zones and political boundaries. Even in cases where such boundaries are not an issue, Indonesia has had difficulty in limiting fishing effort, partly due to ineffective enforcement at all levels.

Obviously there is a strong need for a clearer licensing system, and a firm policy on who can fish in a given fishery. Without these policies sustainable fishery management is impossible.

In reality, enforcement is needed if any of these regulations are to work, and enforcement appears to be focused on foreign fishing vessels, not on the management of national, and locally based boats (see also the report on monitoring control and surveillance).

Limitations on fishing gear are another option open to managers, and this approach has worked well in the past. The banning of trawling in much of Indonesia in 1980 was a considerable help to small scale fishermen. But now, fishermen in many parts of the country are using trawls again, even though they are illegal.

For example, a large proportion of fishermen in East Kalimantan use small trawls, even though these are banned by national law. When asked about this issue one informant (in the office for monitoring, control, and surveillance) started to discuss the process of changing the law to allow trawls in that province. There appeared to be no indication of a need to enforce national law, but rather a need *to accommodate what was already happening*. There was no indication that the reasoning for this proposed accommodation included consideration of resource issues other than the desire of fishermen to use trawls… *a short term, and resource damaging, view*.

This thinking reveals *serious underlying limitations* regarding the enforcement of national laws if the provinces, or districts, or fishermen, don't want those laws. The approach appears to be an effort to accommodate desires, rather than create laws supporting long term sustainability.

Although accommodating the views of fishermen is important, this needs to be done in a more structured environment that protects the long term interests of the nation and the fishermen, and the sustainability of the resource.

Some have suggested that the new, decentralized, role of the central government "is to develop guidelines and policies rather than directly control and manage activities" (Patlis et al. 2001). This may be correct for management of resources falling mostly within provincial waters. Nevertheless there is still be a strong need for

coordination among the various entities involved in regulating overlapping resources, and for the management of resources falling mostly within national waters.

As pointed out by Dahuri (2001) many factors limit the reasonable evolution of a new balance between local and central authority. These include fixed perceptions in the well established centralized agencies, and lack of capacity in the regions. Slowly these limitations are being removed, and improved central – regional partnerships for the management of resources is a strong possibility.

3 IMPROVED ASSESSMENT AND MANAGEMENT OF MARINE AND FISHERY RESOURCES: INPUT FOR MEDIUM TO LONG TERM PLANS

3.1 The Future: Two alternate visions for Indonesian Marine Resources

Vision 1 - Careful management and healthy resources: In this vision of the future: Agencies work to develop the tools, and cooperate approaches to obtain funding, to do their jobs properly. Although data are limited at first, careful planning helps target efforts toward research and management in key problem areas. Management plans are gradually developed for selected fisheries, and implemented in cooperation with provinces, districts and communities. Remaining problem areas are then targeted for improvement.

Fish stocks are managed carefully and fishing effort is matched to the size of the fish stocks. Protected area boundaries and rules are enforced, and are respected by local fishermen. Reserves have healthy fish stocks and provide a spillover effect to nearby fisheries. Inappropriate fishing techniques are eliminated and fish habitat recovers. Catches improve and stabilize.

Careful monitoring and enforcement of environmental laws helps to improve environmental conditions, and also protects the safety of fish products.

Improved fish stocks allow fishermen to fish nearer home and they also respect the fishing areas of other districts. The quality of life for small scale fishermen gradually improves, and conflicts among fishermen decrease.

Development of larger scale fisheries are carefully limited so as to match the size of the stocks being fished. Even though profits are good, new licenses for more boats can occur only after careful consideration. Healthy profits mean better crew salaries, better vessel safety, and ecological friendly fishing techniques. Fishing outside Indonesia is enhanced because Indonesia participates fully in International agreements. Indonesian food quality inspections are recognized around the world, and certification processes are fully developed. Indonesian fish exports are of high value and are respected around the world.

Vision 2 - Management failure and over-harvest: In this vision of the future: Agencies do not have the tools or funding to do their job properly. Planning is hampered by the lack of good data, and in any case, there is no way to implement management plans. Thus, plans exist on paper only.

Fish stocks are fished harder and harder as human needs increase, but the catches decline. Fish habitat is destroyed by excessive, and inappropriate fishing activity and, because there is no monitoring or enforce of environmental laws, by a general decline in environmental conditions. In desperation fishermen are forced to use other methods to catch fish and have to fish within protected areas. They search the sea for new places to fish causing many conflicts with fishermen from other places. Poor small scale fishermen remain poor and their quality of life declines. Larger scale fisheries are overcapitalized; no one is making a profit. This causes a decline in vessel maintenance, quality, and safety, making competition with nearby countries more difficult. Fishing outside Indonesia becomes legally difficult because Indonesia fails to fully participate in International agreements. Poorly qualify food inspection laboratories and the lack of certified fish products limits high value fishery exports.

The question is: Which kind of future does Indonesia want? Following are some suggestions that hopefully will lead to the positive future.

3.2 Develop decision systems to support policy

3.2.1 The need for decision systems

Systems to make decisions need to be established or imporved. Such systems are not just committees, commissions, or working groups, but rather are composed of *sets of policies*. Policies are *agreed in advance* and come into play when a certain situation occurs. So, for example, we might say “if catch per standardized unit effort

drops below xxx tons/unit for more than two years, then we will withdraw licenses for the 10% of vessels which entered the fishery most recently." Thus, we can define a management policy as a specific set of actions that will be carried out under predetermined circumstances. Currently in Indonesia there are *no such sets of policies*. All management is done on an *ad hoc* basis.

> NEEDED ACTIONS: Approaches to establish pre set policies and related "automatic" triggers, and resultant policy determined actions. These should be developed within the context of management plans (see section 3.4), and should be part of the operational aspects of any plan.

Research institutions provide the first step in setting policies necessary to protect the sustainability of fish stocks. These baseline, stock protection policies, should state moderately specific actions needed when stock conditions reach a certain level. Typically these recommended actions will not include final details. An example might be: "If stocks drop below xxx tons biomass then catches should be lowered by yyy tons during the next two years." This suggestion and supporting analysis is then turned over to management agencies for further specification.

The role of management agencies is to use this information, in a pre-agreed manner, to determine *specific actions* to be taken. These actions must be in agreement with the requirements of resource sustainability. Thus, the management agency might set lower numbers of licenses (or uses other techniques) to lower fishing effort. Research agencies should provide suggestions on how to do this, but the ultimate decision rests with the management agencies (i.e. the Directorate General for Capture Fisheries and/or the Minister). Ideally the actions to be taken will have been determined in advance, and all parties will have agreed to these actions in advance. As a part of this approach, details of management, and potential problems, *must be envisioned prior to the occurrence of problems*.

For example, the agency might have a preset policy: "If catch per unit effort drops below xxx per standardized unit for more than 2 years then fishing effort will be reduced by 10%, and this will be accomplished by removing licenses of the most recent boats to enter the fishery."

If all parties have agreed on this policy in advance, *and* there is fair and effective, enforcement, then the implementation is less difficult.

Policies must be in agreement with the requirements for fishery management as set out in Law 31-2004 which is quite specific in defining “fishery management” and “conservation of fishery resources” as the responsibility of government. Nevertheless management systems must be reasonable, affordable, and not overly complex. Thus considerable careful thought must be given to the formulation of these actions (Cochrane 1999).

Considerable information exists on the use of “reference points” in fishery management. This information provides a starting point, for management of fish stocks by setting predetermined triggers that will indicate when management actions are needed (for example see: Caddy and Mahon 1995, Die and Caddy 1997, Fromentin et al. 1999, Marin 1999?, Collie and Gislason 2001, Caddy 2002).

Typically reference points are often derived from standard, data intensive, stock assessment approaches, and if such information is not available, then the development of reference points may be difficult. However, even if sufficiently accurate stock assessment data is not available, other “reference point” approaches can also be considered. For example sometimes fishery management actions can be based on indices of abundance of juvenile fish. For example, if juvenile abundance were to drop below a certain level, then the fishery would be curtailed during the next xxx years.

Other types of reference points can be developed. The basic idea is that good management should include *pre-arranged, agreed upon scenarios* that will be automatically implemented if a certain reference points are reached.

> NEEDED ACTIONS: Develop mechanisms to actually manage selected fisheries, and other resources, with predetermined policies in cooperation with resource users and other stakeholders. This activity should include: selection of target resources, setting management goals, setting of policy framework and institutions, setting research priorities, carrying out needed research, *determining of policies and triggers*, establishment of monitoring program, implementation of management. This should be done as a part of the development, and funding, of fishery management plans (see section 3.5).

3.3 Improve resource assessment and supporting information

3.3.1 Estimating resource stocks

Firstly, it is important to note that *all* stock assessments are *estimates*. Some estimates are better than others. Estimates based on poor data are of limited use and must be treated with caution. Good management based on *limited data* implies management which allows only *limited fishing* and precaution – until better information is available.

On the other hand catches are a source of information, and monitoring of catches and the recording of accurate fishery statistics is a vital support for better management. Of course research programs involve many approaches and only some of these rely on fishery statistics.

3.3.2 Sustainable yield: Need for a new paradigm

At present most fish stock assessment, and management, in Indonesia is based on the use of surplus production models which were originally developed for single species management. While these approaches provide an underlying theoretical background on which to base decisions, their use is often inappropriate and can lead to unwanted consequences, *even if* policies are effectively created, implemented, and enforced, which they are not.

In Indonesia there is the additional problem, seen in some reports, of a misunderstanding regarding the relationship between fishing effort, fish populations, and sustainable yield. These reports *incorrectly* imply that if the current catch is below the total allowable catch then more fishing should be allowed. This misunderstanding *fails to consider that low catches can be, and often are, caused by over-fishing*. This misunderstanding is easily rectified, but other problems remain.

Throughout the world, including in developed countries, serious questions are being raised about the way in which fisheries are managed. Over-fishing has occurred in some of the worlds most well studied fisheries. Because of these failures, some aspects of the concept of sustainable yield have been criticized as inappropriate.

Much of this criticism is directed at the specific meaning of "maximum sustainable yield" as determined by certain mathematical approaches to fish stock assessment, especially the widely used, and easily interpreted, surplus production models. Some

criticism of the maximum sustained yield approach is justified, *but the general concept of sustained yield* is useful. Maximum sustainable yield can be thought of as the size of catch that can be harvested each year without harming underlying fish stocks *or environment* over the long term.

This redefined concept of sustained yield must now include consideration of natural variations in stock size and the underlying factors which causes those variations. For these reasons sustainable yield *might not be constant* from year to year. This fact suggests that a more cautious management approach is necessary, and that fishery regulations will have to adjust to changing conditions.

Nevertheless, sustainable yield is still a reasonable idea for thinking about resource management – the idea that there is some level of *sustainable* catch. However, instead of thinking about a fixed amount of catch per year, Indonesia's assessment and management programs must consider the dynamic influences on fish stocks including: climatic variations, predator prey relations, other interspecies interactions, and the effects of fishing activity on the fishery and environment.

Consequently, it is important for Indonesia to move toward a better understanding of these dynamic interrelationships, and to incorporate this type of knowledge into new paradigms for fishery management. Ecosystem management is further discussed in section 3.6.1.

Models are an unavoidable, and important, component of fishery management planning. Models can be mathematical (as in the case of surplus production models), computer models (many types), or mental models – the way in which we *think about* how a fishery will respond to management. Any of these models can be wrong. In fact every type of model has its faults – all models are wrong, but some of them are useful. The best approach for management will depend on the situation, but often mathematical or computer models, if used correctly, *can improve our mental models* to help us understand how a fishery works.

For example, dynamic interrelationships, like those which occur in fisheries, are best understood through the use of system dynamics models – a specialized type of computer model for which specialized software is available (e.g. Vensim www.vensim.com) . Ecosystem energy flow models have also been used to

understand fishery ecosystems, and software for those is also available (e.g. ecopath http://www.ecopath.org/).

There are many opportunities for Indonesian researchers and managers to move beyond the surplus production modeling paradigm. Some Indonesian researchers already have these capabilities. However, there are two important points to keep in mind. 1)People using models must be well trained, and must understand the use *and limitations* of models – models are thinking tools. 2)Management agencies must also have an understanding of, and willingness to use the results of models. If model results are not used, then the development of models will only have been an academic exercise.

> NEEDED ACTIONS: Training programs, and parallel development of programs for higher education, on alternate views of fishery management that incorporate concepts of ecosystem based management, the role of protected areas, the consideration of climate fluctuations, and interspecies relationships. These should be directed at developing the broader perspective of fisheries as an activity imbedded within larger ecological- socio-economic systems. Such programs might include system dynamics modeling and ecosystem modeling. Development of "flight simulator" type models and models built in cooperation with fishery managers using well established group model building protocols.

3.3.3 Improving science for management

3.3.3.1 The scientific community and research

One of the difficulties in fishery management is the fact that resources can only be estimated, and those estimates are obtained only with expense and difficulty. Also fish stocks are dynamic, constantly changing in response to harvest and environmental factors. To support their resource assessment work, researchers must constantly review and consider new scientific findings and statistical information about the resources in question. The very diverse nature of Indonesian fishery and related resources, and the extremely varied marine fauna, sometimes make the task of resource assessment seem impossible.

Nevertheless, a considerable, and increasing, body of scientific papers, research reports and other documentation both from within Indonesia and from elsewhere is

available to support fisheries decision making. This information is becoming increasingly available via electronic journals and through electronic exchange among scientists. In addition, a wide variety of international fishery research organizations provide support for such efforts, including provision of information via the world wide web. For this reason, it is essential that Indonesian scientists have better access, from laboratory and office, to these electronic resources and to existing and potential colleagues.

Unfortunately, some government officials do not understand difficulties facing fisheries researchers, and this is reflected in an attitude that very clear information is needed prior to making any management decision. Obviously decisions should not be based on bad data, but following the precautionary approach poor data should result in *less fishing* and in cautious decisions leading toward less intensive exploitation. Following this guideline, increased fishing should be recommended only when good data are available, and bad data should not be used as an excuse to allow continued over-fishing.

Obtaining to up-to-date scientific information is a problem for scientists everywhere. For various reasons marine resource information in Indonesia has been published, either in obscure reports, or in expensive or unavailable scientific journals. Significant world wide efforts are now underway to change this system, and to encourage publishing in “freely available” journals. Those Indonesian scientists who write reports and publish scientific papers should work to ensure that their contributions are as widely available as possible, especially to their colleagues in Indonesia. Indonesian research agencies should adopt policies to ensure their documentation is widely available. Most ministries have already started this process via web sites available to the public, as have non-governmental organizations. This approach should be expanded and encouraged in a professional manner.

Because journals can now be published electronically, costs of publishing should no longer limit the careful but rapid dissemination of Indonesian research efforts. Indonesian journals can now be made freely available and all researchers and managers should have access to up-to- date information. However, the *quality of this research still needs to be assessed* by competent and unbiased reviewers and editors.

Another issue for Indonesian scientists is use of the English language. It is an unfortunate fact of scientific life that many scientific papers are published in English. Thus access to the latest ideas and information requires a reasonable knowledge of that language. The governments should continue to encourage its wider use among Indonesian scientists and resource managers. This does not mean that information in Indonesian or other languages (e.g. Japanese) are not important, but merely that, at present, more information is available in English. Workshops designed to improve report, technical and popular writing, and proposal preparation, (in both English and Indonesian) would be helpful.

Professional societies can play an important role in improving the quality of scientific work. Indonesia has at least two professional societies for fishery scientists: Masyarakat Perikanan Nusantara (the Indonesian Fisheries Community), and Ikatan Sarjana Perikanan Indonesia (the Indonesian Association of Fisheries Scholars) which is a sub-organization of the first. The first consists of well-known senior personnel (and houses a number of sub-organizations representing industry, scientists, cooperatives etc) and the latter is open to all fishery graduates. Apparently there are also ad hoc organizations within and among Indonesian universities.

These and similar organizations, *if sufficiently independent of government influence*, can promote good science and its use in fishery management. The independence from government is required to promote independent thinking which may, at times, conflict with government policy, or with views of powerful individuals in government circles. Participation in these organizations should be rewarded and encouraged.

> NEEDED: Better support for all Indonesian scientists (at government agencies, universities and the non-governmental / private sector) to access and use new information resources. This support should include actions, and equipment acquisition, to improve computer communications and web access from all offices, and should provide training in such technologies where appropriate. This support should also improve links (and build on existing ones) among marine resource workers in different ministries, local government, and communities where possible, and the private sector. Incentives should be provided for personnel to improve English language

abilities and opportunities to visit international fishery research and, especially, management, facilities.

3.3.3.2 Supporting data

3.3.3.2.1 Standard fishery statistical data

Fishery statistical data is essential for good fishery management both from a resource management and a business perspective. Given the size and complexity of the fishery sector, reasonable reports are provided within a few years of data collection (Anon 2005c, d). Nevertheless, a number of people have expressed concern that the accuracy of fishery statistics is low and that poor statistical information hampers stock assessment efforts. The current system for collecting fishery statistical data is in need of better support, partly due to changes caused by decentralization. A program to improve this system was started in 2005, and such improvements should continue, and should be encouraged and supported.

Because of the limitations, additional collection of catch and effort information is carried out by the research agencies on an "as needed" basis (also see next section). This duplication requires extra time and effort from researchers which could be better used for necessary biological and other stock assessment research.

Improvements to the fishery statistics system will require a gradual, sustained, effort throughout the country. Improvement is especially needed at the field data collection level. Responsibility for data collection at this level is now more widely distributed among the various provincial and district offices, some of which do not understand the importance of these statistics. Programs to improve the statistical system, and its support for research and management, must include coordinated improvements, and *funding*, for both centralized and localized activities.

NEEDED ACTIONS: continued revitalization of the fishery statistics system, especially taking into account changes, and funding issues, created by decentralization.

3.3.3.2.2 On-board observers and special sampling programs

Another approach, very useful in some fisheries, is the implementation of special fishery statistical data collection programs for specific fisheries. These can be at fish landing areas, fishing ports, or on-board fishing boats.

On-board observer programs are a good option when there are issues related to catches being transferred at sea, or where there is a need for information about by-catch, which might be discarded, or information about the specific fishing location. Such programs are suitable for larger vessels. On-board observer programs are also useful for monitoring fishing vessel activities and for enforcement, *but such use may be difficult, and counterproductive, unless the observers are given extremely good logistic and legal support.* An on-board observer program was already recommended 10 years ago (Gillett 1996).

On-board programs and specialized port sampling programs have been an occasional component of data collection in Indonesia, but could become a standard tool for key fisheries. An example onboard observer program for Indonesia has been developed (Anon 2005a), and a recent special tuna sampling program in Bali resulted in "some of the best existing" data for the Indian Ocean longline fishery (CCSBT 2005).

Thus, it is possible to obtain better data to support management on a case by case basis. Now the challenge is to make such data collection programs a regular complement to the standard fishery statistical data.

> NEEDED ACTIONS: Implementation, and funding for, a regular program of intensive data collection and research programs for key fisheries. This could take the form of a special team of data collection specialists who would be assigned to formulate and carry out needed supplemental data collection programs. However, because of the need for long term fishery data, this should not be done at the expense of , or to duplicate, the fishery statistical system.

3.4 Improve institutional professionalism at district and provincial level

As marine resource management activities move to the province and district level, the need for fishery professionals at these levels will increase. Currently, even at the district level in West Java, home to several good universities, only about 30% of the workers have fishery backgrounds, and many workers are given multiple tasks which combine fisheries with other disciplines (Anon 2005e). If decentralization is to have a positive impact on marine resource management, the institutions (e.g. the fisheries

service) must have dedicated and well trained professionals who understand resource issues and the fisheries. This same problem may exist at the provincial level in some areas. Since there are a number of fishery universities located throughout Indonesia, the graduates of those universities should be available to fill the appropriate posts. Nevertheless, the quality of some university programs may be sub-standard and efforts should be made to provide those programs with additional support.

> NEEDED: A reexamination of the professional requirements at the district and provincial fishery offices in light of the additional technical responsibilities devolved to those offices assignments. Professional staff need to be recruited there, and in time professional staffing at the national level may be reduced.

3.5 Development and use fishery management plans

Background

The concept of fishery management is well developed. In very general terms fishery management includes the setting of overall goals of management and means of attaining those goals. Typically this process involves the collection of information of all types, analysis of this information, and the development and implementation of a course of action. These actions then cause new information to be made available (e.g. new catch rates, new numbers of vessels, changes in the ecosystem etc), and this information then becomes part of the new data (Figure 1).

A multitude of fishery management approaches exist and some of these have been outlined in the useful, and free, FAO volume edited by Cochrane (2002). This provides, for example, a set of basic principles of management (Table 1). Of course management must go beyond the general considerations presented in Table 1 to provide detailed rules, regulations and decision processes. Some possible approaches are described in section 3.6.

Fishery management plans help to operationalize the management process by focusing on a particular fishery. Indonesia has already designated 9 fishery management areas, and has started to manage fisheries within them. This is a good start toward comprehensive management of marine resources. However, since species by species management is unlikely to be successful, and generic group management (e.g. “large pelagics”) is too general, a different approach is needed. In

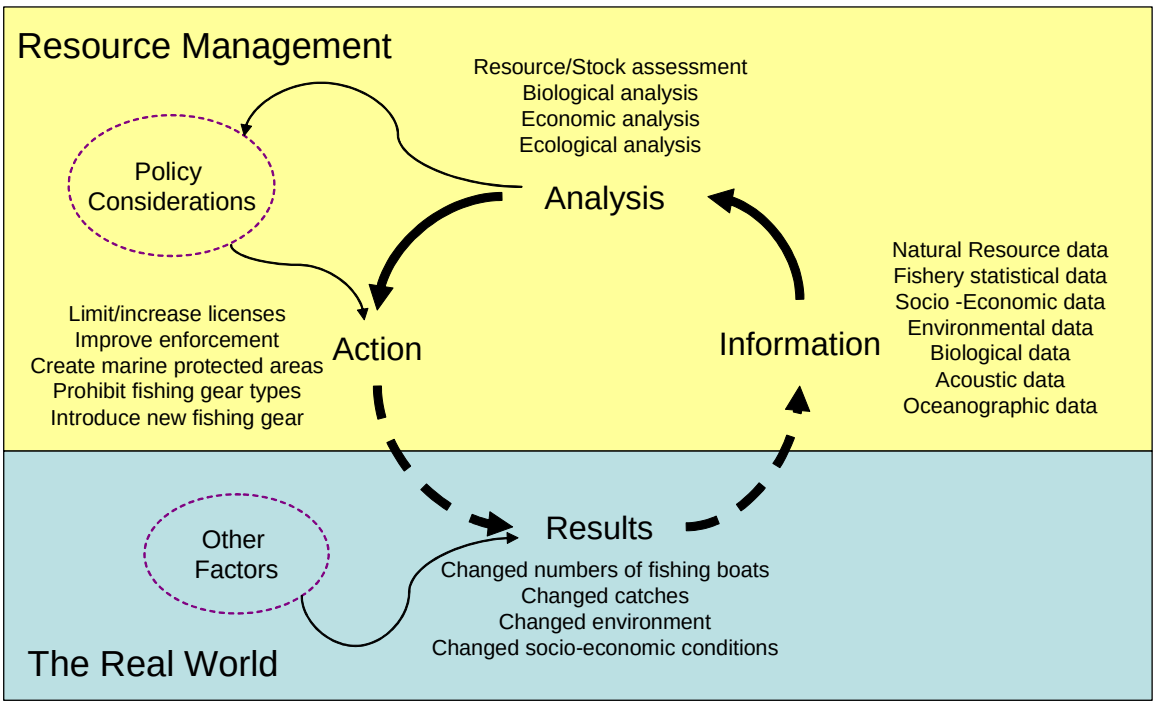

Figure 1. Generic view of fishery, or other, marine resource management. Management involves the collection of information, its analysis, and the formulation and implementation of actions. These actions affect the resource and harvests from the resource and this generates new information. Actions are also affected by prevailing policies and those policies may be affected by the results of analysis. Of course other factors, besides management actions, also affect the real world.

Indonesia, fishery management plans, within the existing fishery management areas, are a reasonable starting point.

But management plans must be created for selected fisheries, not the whole management area – not merely for a geographic region. *Boundaries must be biological and ecological as well as geographic*.

In some cases the identification of the target fishery will be easy, with fairly obvious biological, ecological, and geographic boundaries (e.g. Java Sea small pelagics). In some cases it will be necessary to add a technological, fishing gear, boundary as well (e.g, Java Sea small pelagics – large purse seines).

In other cases identification of the fishery will be more difficult, as in the case of a widespread but moderately migratory group of species (e.g. perhaps snappers (family Lutjanidae), or jacks (family Carangidae). In these cases a fair amount of

Table 1. Some basic principles of fishery management taken from Cochrane (2002).

	Principle	Management Function
1	Fish stocks and [fish] communities are finite and biological production constrains the potential yield from a fishery.	The potential yield needs to be estimated and the biological constraints identified.
2	i) Biological production of a stock is a function of the size of the stock and	i) Target reference points need to be established through data collection and fisheries assessment; and
	ii) it is also a function of the ecological environment. It is influenced by natural or human-induced changes in the environment.	ii) environmental impacts should be identified and monitored, and the management strategy adjusted in response as necessary.
3	Human consumptive demands on fish resources are fundamentally in conflict with the constraint of maintaining a suitably low risk to the resource. Further, modern technology provides humans with the means, and demand for its benefits provides the motivation, to extract fish biomass at rates much higher than it can be produced.	Realistic goals and objectives must be set. Achieving the objectives will inevitably require controls on fishing effort and capacity.
4	In a multi-species fishery, which description encompasses almost all fisheries, it is impossible to maximize or optimize the yield from all fisheries simultaneously.	Realistic goals and objectives must be established across ecosystems, so as to manage for species and fisheries interactions.
5	Uncertainty pervades fisheries management and hinders informed decision-making. The greater the uncertainty, the more conservative should be the approach (i.e. as uncertainty increases, realised yield as a proportion of estimated maximum average yield should be decreased).	Risk assessment and management must be done in development and implementation of management plans, measures and strategies.
6	The short-term dependency of society on a fishery will determine the relative priority of the social and/or economic goals in relation to sustainable utilization.	Fisheries cannot be managed in isolation and must be integrated into coastal zone and fisheries policy and planning and national policies.
7	A sense of ownership and a long-term stake in the resource for those (individuals, communities or groups) with access are most conducive to maintaining responsible fisheries.	A system of effective and appropriate access rights must be established and enforced.
8	Genuine participation in the management process by fully-informed users is consistent with the democratic principle, facilitates identification of acceptable management systems and encourages compliance with laws and regulations	Communication, consultation and co-management should underlie all stages of management

biological information may be necessary and coordination with other countries may be helpful (e.g. see Blaber et al. 2005). Management plans for highly migratory species (e.g. large tunas) are best made in cooperation with international organizations set up for that purpose (e.g. the Indian Ocean Tuna Commission). Nevertheless, there may be some fisheries that can be defined by a single type of boundary (e.g. in special cases, by geographic region only).

Die (2002) outlines steps to be taken in developing fishery management plans. Most importantly a fishery management plan, because it is tailored to a specific fishery, can be made locally appropriate – it can mesh with regional or local requirements and customs if necessary. As he points out, the code of conduct suggests that:

"The management plan provides *detail* on how the fishery is to be managed and by whom. It should include a management procedure which gives *details* on how management decisions are to be made in accordance to developments within the fishery…"

In Indonesia it would be best to *first develop* management plans which focus on specific fisheries that are in trouble, that have a lot of potential, or have high value. Other fishery plans can be implemented later. So, the first step is to *prioritize fisheries* by need within each fishery management area.

Development of management plans has already been attempted in Indonesia, most notably for the Bali Straits sardine fishery (FAO/FISHCODE 2001, Ghofar 2002?). However, in spite of many years of work the management of that fishery is poor, the fishery is over-fished, and both fishermen and processors are the losers.

Some recent Indonesia fishery programs referred to as fishery management plans are not plans in the sense discussed here, but are old style fishery development programs disguised as fishery management plans (e.g. Anon 2005b). This serves to highlight an underlying problem in fishery management in Indonesia. In the past, fishery "management" has been viewed as the provision of "gifts" to fishing communities. It has consisted primarily of fishery "development" consisting of various types of subsidies, and infrastructure projects. Although well intentioned and sometimes helpful, that approach *does not* manage fisheries in the sense of balancing fishing activity with the ability of the resource to produce fish or other products.

Management of any fishery is a matter of reaching a balance between the resource and the fishery exploiting it. Management must also take into account how this balance is to be reached with consideration given to societal issues such as employment, equity, and other benefits. The criteria for success of fishery management must be well defined. How will good management be measured? Fishery management plans are one reasonable framework of answering this question and for attaining better management.

3.5.1 Some example targets for management plans within selected fishery management areas

3.5.1.1 Shrimp

Shrimp is a high value product. Efforts should be made on ensuring that this high value is realized by the Indonesian shrimp industry, and that it is equitably shared among fishermen, processors and exporters, and provides tax revenues when appropriate.

It is possible to over-harvest shrimp although over-harvest is usually in terms of optimal (most valuable) size at harvest, rather than danger of stock collapse. Attaining an optimal harvest size is difficult in cases where there are artisanal fisheries for juvenile shrimp. Unfortunately, there are also many small species of shrimp which are targets of artisanal gear, and these gears may also catch juveniles of valuable, larger, species. Management plans might be arranged so that selective closed seasons can protect juveniles of valuable species, while protecting the income stream of artisanal fishing communities. Note that the added value to larger scale fisheries can be viewed as an *environmental service* that is provided if artisanal fishers fish less. This value could possibly be considered as a target for some form of compensation paid by large scale fishers, perhaps funded via the normal tax on shrimp landings.

At present wild-caught shrimp do not command special prices due to better taste or ecological issues, although this might possibly occur in the future (see certification in section 3.6.6.2). Because to the dominance of aquaculture shrimp in the market, shrimp prices tend to follow the price for aquaculture shrimp.

Shrimp tend to be relatively local stocks with no very long migrations, but catches are rather seasonal, and some migration does occur. Valuable shrimp species (of the

genus *Penaeus*[1]) tend to occur close near shore and are thus readily available to small scale fishermen using traditional fishing gear. This provides a valuable resource for small-scale fishermen, and there seems to be little need to develop, or assist, large scale shrimp fisheries, except in special situations.

Trawling, especially to catch shrimp, is gradually returning to western Indonesia after having been banned in 1980, and this is a potential serious problem for small scale fisheries, and for fisheries resources in general. Trawling has an adverse effect on fishery habitat and is fuel inefficient. It usually results in a high bycatch, and a lower quality shrimp product.

Also of interest in any shrimp management plan is the relative role and value of the three main groupings of shrimp: jerbung, mostly *Penaeus* species, dogol mostly *Metapenaeus* species and krosok largely *Parapeneopsis* species. These all contribute to the fishery and have differing ecology and are often caught by different fishing gear.

The potential catch of Indonesian shrimp was previously estimated at 100,000 t (Unar and Naamin 1984). Current catches, including all types of shrimp are listed as 234,000 but that estimate includes “other” shrimp (about 100,000 t) which were probably not included in the previous estimate. Some of these other shrimp are very small species (e.g. *Nematopalaemon* sp.) which are typically processed into shrimp paste. It is also likely that some shrimp produced in aquaculture facilities are accidentally included in sea-caught shrimp statistics as these are sometimes sold at fish landing places. In any case, the value of sea caught shrimp is several hundred million US dollars per year.

Fishery management plans for shrimp can help address some of the above issues and can help ensure that participants in the fishery receive full value for their product. Issues covered in such plans *might* include: closed seasons to produce optimal size and value, closed areas to allow movement of juveniles to the fishing ground from

[1] Some workers have elevated several *Penaeus* sub-species to the species level.

nursery areas, allocation of catches to small scale and large scale fishing gear, and the limitation of fishing gear to optimize profit per unit effort. Consideration might also be given to closed areas to protect nurseries, control of aquaculture facility construction and operation which may adversely affect shrimp habitat. Management plans for shrimp must be developed on a case by case basis for selected areas probably starting with the Arafura Sea, the North Coast of Java (and nearby areas), and the Cilacap area. Other areas may also be appropriate.

The Arafura Sea fishery may need to be quite different from the others due to the large size of many of the trawlers and the complex management problems associated with trawlers, particularly the catches of demersal fish as well as shrimp, and destruction of bottom habitat.

3.5.1.2 Java Sea small pelagic fisheries

There is a large amount of information on the Java Sea small pelagics fishery (McElroy 1991, Durand and Widodo 1995b, a, Widodo and Durand 1997, Roch et al. 1998, Squires et al. 2003, Pasaribu et al. 2004) and several earlier studies. Several projects have targeted this important fishery for improved management. Unfortunately, these efforts have failed. The fishery is overcapitalized by as much as 100%, and boats have gradually made longer and longer trips to find fish. This has led to conflicts over fishing grounds. This fishery is an ideal target for a comprehensive management plan, but such a plan will be a challenge to implement.

According to Squires *et al* (2003) in the past there was too much policy emphasis on credit programs, infrastructure development, training programs, and development of advanced fishing technology. These created excess fishing capacity which has created a sub-optimal, low profit, fishery. These same conditions were also reported earlier (McElroy 1991).

Clearly the management of this well studied fishery has been a failure. There are too many boats. There are conflicts. Catches are dropping in spite of overall improvement of fishing technology.

The fish species involved are relatively short lived with high growth and reproductive potential. Recovery of this fishery to optimal levels should take only a few years under careful management. Within 10 years this *could be* one of Indonesia's most successfully managed fisheries.

Because the large number of participants, impact on both large scale and small scale fishermen, and importance to several provinces, this fishery should be a target for improved management via a management plan. Nevertheless, these same characteristics make it one of the more challenging fisheries to manage. It is an ideal target for a nested co-management program involving national, provincial, district and community levels.

3.5.1.3 Terubuk *(Tenualosa macrura)* recovery plan

Recovery plans have the same structure and function as fishery management plans except that the primary goal is to rebuild a seriously depleted resource.

One example of a severely depleted fishery resource is the terubuk (*Tenualosa macrura*) a estuarine shad which was formerly the basis of a major fishery in Riau. This species also have a special cultural significance for people of the area. In fact the city of Bengkalis is known as Terubuk City. Two similar species (one in the Mekong River, and another in Northern Borneo) are also severely depleted.

Terubuk was the basis of a major fishery in the past, but that fishery has now shrunk to a small area in the estuaries of Riau Province. Fishing takes place during the full and new moon, and targets females with eggs during these spawning periods. It has also been found that these fish start life as males and change into females. This a short lived species, typically living only 2 years. Because the fishery targets females during the spawning period, the fishery has collapsed (Blaber et al. 1999).

In addition, there is a problem related to a special type of pollution. Sawmills along these estuaries dump sawdust into the rivers. The terubuk mistake this sawdust for plankton and eat it. Sawdust has no nutritive value. The fish starve to death (Brewer et al. 2001).

These appear to be relatively obvious problems. However, there are other complicating factors. Young terubuk are also caught in other fishing gear, especially in shrimp trawlers (which are actually illegal in this area) operating in the same inshore estuarine areas.

Because this is a well defined fishery it should be a reasonable target for a management plan.

3.5.1.4 Other possible targets for management plans

Inshore demersals (small-scale gear):

Offshore demersals (bottom gill, net traps):

Pelagic large mesh gillnet:

Inshore seines and liftnets:

Ikan Layur Hightened interest in this species may warrant the development of a management plan. But migratory nature (?) may make this difficult (Badrudin and Wudianto 2004, Muhammad 2004, Sondita 2004).

Trochus A recovery plan may be appropriate. Place-based nature of this resource (?) may make a protected area approach more appropriate (Evans S.M et al. 1997)

> NEEDED: The funding of projects providing salaries and a modest budget to create management plans for selected fisheries. These should be long-term (e.g. 5 to 10 years) and should include staffing of a management body to implement a plan for each specified fishery. These projects should pre-specify specific performance measures for the successful management. Salaries could be partially dependent on performance of the fishery, not on sales of licenses. Performance might be based, for example on externally monitored spawning stock biomass, and nearness to targets of fishing fleet size and composition, and catch levels. Taxes on landings, and profits from related fishing industries, could be used later to fund the system. These should be a well defined fisheries such as shrimp (Cilacap, Arafura Sea), Bali Straits sardine, Java Sea purse seine.

3.6 Develop better approaches for management within management plans

3.6.1 Follow code of conduct for responsible fisheries

The code of conduct for responsible fisheries was first published in 1995 (FAO 1995). Although the code is global in scope, it provides, in fairly general terms, the

requirements for responsible fisheries management, including within-country management.

The code provides a specific section on fishery management in its section 7. This section discusses the need for fishery management plans or other management framework, the need for fishery statistics, and the need for biological, economic and social research.

A number of other issues are mentioned in the code. Nevertheless, the code consists of only:

> "principles and international standards of behavior for responsible practices with a view to ensuring the effective conservation, management and development of living aquatic resources, with due respect for the ecosystem and biodiversity."

In other words this code *does not provide detail* of management approaches, or even detailed goals of management. It provides *a framework* within which the goals and details of management should be developed. This framework has already been examined in relation to Indonesia's needs (Direktorat Kelembagaan Internasional 2003). Now the task is to continue to implement this code in a meaningful way.

> NEEDED: Support to implement the code of conduct in a meaningful way so that Indonesian fisheries can be managed in accordance with this code.

3.6.2 Implement ecosystem based management

"Ecosystem based management" is the new paradigm for fishery management, but it is really an extension – part of the gradual improvement – of existing fishery management ideas (Garcia et al. 2003). Nevertheless, the *means of implementing* this ecosystem approach is still under development. Garcia *et al* (2003) provide some guidelines, but the most important of these is the idea of *understanding fisheries as part of a bigger ecosystem*. Fisheries have a significant impact on this ecosystem, and that impact is almost always negative. Ecosystem based management strives to minimize those negative impacts.

Negative impacts can be physical damage caused by fishing gear, or can be ecosystem alteration caused by the removal of fish, or other organisms. Usually both types of impacts occur. Physical damage is usually destruction of habitat, especially that caused by the use of trawl or similar gear, thus the return of trawling to Indonesia is a significant problem. Trawls damage bottom habitat causing an overall decrease in ecosystem productivity. It is important to remember that trawls are dragged back and forth over the same area hundreds of times a year, creating massive ecosystem disturbance (e.g. Fogarty and Murawski 1998).

Removal of target and non-target species, by trawls and other gear, is another significant problem. Removal of more than just a few fish creates a subtle changes in the ecosystem. Removal of large amounts of fish can create big changes. Sometimes these changes are long lasting, adversely affecting both fisheries as well as the supporting ecosystem. One of the difficulties here is that “fishing down the food web” will occur. That is, predator species (which are less abundant), and larger species, will disappear from catches leaving smaller, usually less valuable, species to be caught. This phenomenon, which has occurred in several fisheries, results in less productive fisheries and reduced biodiversity (Pauly et al. 1998).

The key elements of ecosystem based management are 1) the use of non-damaging fishing gear, 2) the careful targeting of desired species for harvest, 3) the removal of small enough numbers of fish so that the ecosystem remains intact.

The first of these elements may be the easiest to achieve, *but* in Indonesia the opposite appears to be occurring via the unofficial return of trawl fishing to Indonesia. This will ultimately cause over-fishing and conflict. Even in countries with strong fishery management policies there are problems with trawling because of its significant destruction of fish habitat. Indonesia was formerly a leader in limiting trawling. Note also that trawling is also less fuel efficient than other fishing methods.

A study on the effects of shrimp trawling in the Arafura Sea (Anon 2000) could not report any findings related to habitat destruction because there was no research data available.

The idea of using ecosystem based approaches has been investigated for some Indonesian fisheries. Buchary *et al*’s examination of the Bali Straits sardine fishery with an ecopath model is one example (Buchary et al. 2002). They pointed out that

the methodology is helpful in visualizing and comparing possible effects of different management strategies, but they also comment on the need to include effects of natural climatic variations.

This and other types of ecosystem modeling may be helpful in working out management approaches for key fisheries. Robinson and Frid (2003) provide a summary of modeling approaches for examining ecosystem effects.

Marine reserves can, and should, form one component of ecosystem management approaches (see section 3.6.3). Reserves can protect a portion of fish stocks and remove the effects of fishing gear.

> NEEDED: Implementation of ecosystem based approaches and the development of methods of evaluating these. Efforts can start with the 1) gradual switchover to less damaging fishing gear, 2) the development and use of more selective fishing gear, and 3) the development of ecosystem criteria for management of key fisheries. Ecosystem based management should be a basis of fishery management planning especially in cases where fishing gear are known to be destructive.

3.6.3 Make use of marine protected areas

Valid arguments have been made for the increased role of marine protected areas (also known as marine reserves) in Indonesia. The development and expansion of these areas is desirable from *both a conservation and a fishery perspective*. In fact, marine protected areas are a valuable tool for fishery management and can supplement, or even replace, standard fishery management approaches under certain conditions (Mous et al. 2005).

Although the utility of protected areas in conserving the resources within them is well established, their potential value for nearby fisheries is more complicated, and raises several questions. What level of protection is necessary within a protected area? How effective is that protection? How big should protected areas be? Is there a single protected area or a network of areas?

Also of interest is the potential role of non-reef marine protected areas. Some researchers believe that such closed areas provide an easy solution which will lead to improved fishery management. But the science of marine protected areas is relatively new, and many questions remain unanswered (see also Section 1.4).

Protected areas which have been, or will be, established as marine parks and other special areas have additional beneficial affects for fisheries. But the primary focus of management within these areas should be to attain park-related goals. Other protected areas may be established specifically for fishery purposes: to protect spawning aggregation sites, nursery areas, or other special habitats, or to establish a no-fishing (or restricted fishing) zones that will allow fish to grow and reproduce, and will allow full ecosystems to exist without negative effects of fishing as described in section 3.6.2.

Some have suggested that marine reserves should be a major component of fisheries management programs (Holland and Breeze 1996, Holland 2002, Mous et al. 2005). Indeed, marine reserves fit well with the precautionary approach to fishery management. Marine reserves have been shown to be better at protecting fish stocks compared with other, more common, management options (Lauck et al. 1998).

Interest in marine reserves over the past 10 years has stimulated both field and theoretical research. Field studies confirm that fish populations, and related environment, recover relatively quickly when a reserve is created (Pet-Soede et al. 2001). Also confirmed is the idea that fish populations outside the reserve will also improve due to spawning within the reserve (e.g. Stobutzki 2000) and to migration of excess fish from within the reserve (e.g. Abesamis and Russa 2005). Reserves can even benefit migratory fishes (Roberts and Sargant 2002) although these benefits are less clear.

Inspite of all the positive aspects of marine reserves, findings from theoretical (computer modeling) studies shows us that any benefits will be highly dependent on both reserve size and location of one reserve to another. The need for *networks of reserves* is confirmed by both field and theoretical studies. Use of networks of fishery reserves can also ensure that major disturbances in one area will not completely destroy the protected fisheries and biodiversity. Such disturbances might

be human-caused (e.g. oil spills) or natural (e.g. disease outbreaks) (Allison et al. 2003).

The minimum size of protected areas is an important consideration. Occasionally we find that districts or villages will attempt to set up protected areas of a very small size. This is an interesting experiment, and may lead to a positive community awareness. However, technical studies have revealed that small reserves will have little, or no, widespread positive impact on fish and invertebrate communities. On the other hand, very large reserves will necessarily limit fishing area, although benefits to biodiversity will be greater. Finding the optimal reserve size may be a challenge.

Importantly we must remember that protected areas *are not a substitute for well managed resources*. Reserves should be seen as an important component of a resource management system. Ideally there would be a well regulated harvest outside protected areas and no harvest, or very limited harvest, within protected areas.

There is a disturbing trend in Indonesia whereby marine reserves (and terrestrial reserves) are managed, at least in part, for controlled harvest, rather than for protection. This tendency leads to the perception that protected areas are to be managed carefully for use, and areas outside protected areas are a *no-management zone!* To realize their full benefit, the ideal goal within protected areas should be *full protection* with careful management outside the reserve. If some harvest within a reserve is necessary for the reserve's existence (e.g. to obtain cooperation from local communities) then that should be accommodated, at least on a temporary basis.

Overall the role of marine protected areas is very positive and important. Existing reserves should be well managed, and more reserves should be designed and created. Benefits, and costs, of these reserves should be documented as well as possible. These benefits and costs should not only include financial benefits (tourist income, staff costs), but should also include fishery costs (lost fishing area, farther distance to fishing ground) and benefits (more fish in adjacent areas, protected spawning grounds) as well as costs and benefits associated with marine biodiversity).

> NEEDED: Establishment of marine reserves for fishery purposes. Creation of these reserves could start the establishment of "special management areas" where enforcement of more restrictive fishing rules applies. These could

ultimately be designated as marine reserves in the future. Marine reserves should be seen as a part of an overall fishery management strategy. A program should be established to identify and prioritize key areas as marine reserves, including seasonally closed areas, and restricted fishing areas, for each fishery management area. Importantly, appropriate methods of enforcement of special rules within reserves must be an important part of this strategy.

3.6.4 Use care in applying aquaculture "solutions"

Aquaculture production has grown significantly over the past several decades. Its contribution to the economy is substantial. But, as aquaculture gains in importance its negative consequences have been felt, especially its negative effects on marine ecosystems and related fisheries. Because a companion report covers aquaculture issues only a few comments are provided here.

One important issue, related to coral reef fishes, is the "live fish trade" which involves capture and export of live grouper and other reef fishes for restaurants (especially in Hong Kong). When smaller specimens are captured they are grown to an acceptable size in cages prior to sale. The fact that small fish can be grown this way has created a huge market which, in turn, has placed an unsustainable fishing pressure on these fish populations.

The relationship between fish culture and fishery management is seen in this live fish trade question. The restaurant market for live fish causes an over-harvest of juvenile fish of these species (grouper and others). While fish culture is a possible solution to over fishing, the capture of juvenile wild fish by any means is usually more destructive than other forms of fishing. It catches juvenile fish before they can spawn, often also upsetting the ecological balance of the ecosystem by removal of important predators.

If aquaculture is to provide a solution to live fish trade problem it should not be through the capture of juvenile fish for pen raising, but through the development of marine fish hatcheries to provide the fingerlings for raising (Mous et al. 2006). Also important to consider the source of food for cage-raised fishes. This food is often taken from the wild, and this harvest might also stress existing resources.

Another widespread, and well reported, problem is the conflict between protection of mangrove habitat, which supports fisheries and forestry activities, and the conversion of mangroves to shrimp culture facilities. It is well known that mangroves are a productive coastal ecosystem, and are especially important as natural shrimp nursery areas. Efforts to protect these ecosystems should continue, and any aquacultural developments should be well regulated (see additional comments in the aquaculture report).

3.6.5 Account for natural fluctuations when managing marine resources

Fish populations are affected by the natural environment, and the natural environment fluctuates. Spawning success for some species varies widely from year to year. Growth can also vary. Some of these fluctuations are caused by climatic variations and related changes in ocean currents such as the well known El Niño – La Niña phenomenon.

Fluctuations in the natural environment significantly complicate fishery management. A fishery may suddenly be very productive with high catches, but a few years later it will be unproductive and over-fished. It is often difficult to separate the natural and human-caused effects of these fluctuations. During good years a fishery will attract new boats and other long term investment, then the fishery declines *but the boats remain* because the investment has already been made. These boats then further deplete the resource causing more problems. Is such a problem caused by overfishing, or by natural variation, or by both?

These fluctuations also help emphasize the need for intelligent, and very careful, management approaches. Nowadays we often hear that “market forces” will take care of many management problems. From sad experience *we know that this idea is absolutely wrong*. Fishery investments are often large and long-term – the price of a boat or processing plant. The owner of these investments has little choice but to continue their operation, sometimes even at a loss, if fisheries decline. This continued operation then makes the fishery decline even further. Fluctuating fisheries make this situation even worse (e.g. see Dudley 2003).

Prediction of these fluctuation is problematical, although attempts have been made (Klyashtorin 2001, Yndestad 2003). Nevertheless, we must always take the *possibility* of such natural variations into account in our fishery planning. Many studies of such links between climatic fluctuations and fish stocks have been in temperate zone or artic fisheries (Murphy 1995, Hofmann and Powell 1998, Fromentin et al. 1999), but some have been done in Indonesia, e.g. in the Bali Straits sardine fishery (Ghofar et al. 1999).

Such fluctuations appear to be more common in populations of small pelagic fish, but can occur in almost any fishery. Recently, a few years of temporary high catches of yellowfin tuna, cause an overcapitalization in the Indian Ocean fishery for that species. Indonesia is now paying the price with 50% of the longline fleet staying in port, and thousands of workers unemployed.

Thus, in carrying out fishery planning and management we must conclude that sustainable yield is probably *not constant*, and that years of high abundance should be viewed as a *temporary* phenomenon.

> NEEDED: Incorporation of the reality of natural fluctuations into fishery management and planning paradigms. Better understanding of fluctuations is needed, including the development of management approaches that can accommodate planning for such fisheries. Because fluctuations can stimulate a fishery decline, there needs to be an emphasis on precautionary approaches toward favorable stock assessment reports. This approach should strive to avoid over capitalization in fishery related activities.

3.6.6 Consider additional tools for better resource management (some examples)

3.6.6.1 Develop criteria & indicators for sustainable fishery management

Fishery management plans should have well defined goals and criteria for management. Forest management research has progressed along these lines and there are several guidebooks which can provide a starting point (e.g. Prabhu et al. 1999). Using these and similar guidelines development of locally appropriate sets of criteria on which to base management success can be developed. These sets of

criteria help to answer the question: How will success of a management plan be measured? Indicators of success are developed for each criteria.

Criteria and related indicators can be biological, social, economic or of other types. One criterion might be: “catch per unit effort will not drop below 10 tons per standard vessel per year.” This indicator is relatively easy to measure: the actual catch per standard vessel. Another indicator might be biological: “the population species xxx will always have at least 20 percent of individuals larger than yy centimeters.” Indicators to assess this criteria might require careful examination of fish catches or fishery independent research efforts.

Criteria should be combined with specific time-bounded, realistic management actions that will be taken if a criteria is not attained within a certain time period. In the above example: *If* the higher catch per unit effort is not attained within the next two years *then* the number of boats in this fishery will be reduced by 10%.

Some indicators can incorporate indices of ecological integrity, not just measures of fishery management success. These might include such things as the presence of indicator non-target species, or an unacceptable level of habitat degradation.

Some of the best, simple, indicators are available directly from standard fishery data if that data is examined over a sufficiently long period. These are catch per unit effort and species composition. The first can be a proxy for abundance if analyzed carefully, and the second a measure, in certain fisheries, of ecosystem integrity. Sometimes visual observation is a helpful tool. For example, in some cases butterfly fish diversity has been used as an indicator of reef health.

The literature on fishery indicators has been developing rapidly and provides a wide range of options beyond the scope of this report. A special issue of Marine and Freshwater Research provides a good starting point (e.g. Dahl 2000, Garcia and Staples 2000a, b, Gilbert et al. 2000)

Reference points (see section 3.2.1) can be one source of criteria which provide early warning systems of stock status.

> NEEDED: Support for the development of sets of criteria and indicators of sustainable fishery management. These can for a basis for measuring success of fishery management, and can be used in conjunctions with fishery

management plans. These can also provide a basis for certification programs for selected fisheries (see next section).

3.6.6.2 Use certification as a management tool

Certification is an attempt, usually independent of government, to show that a given resource is managed on a sustainable basis. Often the purpose is to raise the value of products harvested from the managed resource.

The Marine Stewardship Council (http://www.msc.org/html/content_465.htm) has established an internationally recognized certification organization for capture fisheries. Because this certification is done on a fishery by fishery basis (e.g. not on a national basis) individual fisheries can attain certification even when other fisheries are poorly managed. Certain locally managed fisheries of appropriate type could be targets for this approach as could larger-scale fisheries.

The Marine Aquarium Council (http://www.aquariumcouncil.org/) has a certification program for marine aquarium fish. This council is currently working in Indonesia to develop certified fisheries for ornamental fishes.

Aquaculture products can attain certification from the Aquaculture Certification Council (http://www.aquaculturecertification.org/).

Certification is useful in cases where the product is exported to countries where certified products are either required, or are where such products obtain a higher market price. At present the market for such products are mostly in North America and Europe. For certain fisheries certification could be a reasonable target of a management plan.

NEEDED: Support for management of certain selected fisheries as targets for certification. This can include the development of criteria and indicators that must be met to achieve sustainable management of these selected fisheries.

3.7 Develop the potential of decentralized fishery management: province, district, and communities

3.7.1 Clearly define the roles of provinces, districts, and the national government

3.7.1.1 Province and district management – can it work?

Substantial aspects of marine resource management have now been delegated to the provinces and districts. Much of this delegation is based on the physical separation of national, provincial and district waters. This zonation system defines district waters out to 4 nautical miles with provincial waters extending from 4 to 12 miles. Provinces and districts have also been delegated the authority to license fishing boats of smaller sizes (3 to 10 GT for districts and 10 to 30 GT for provinces) with larger vessels requiring a national license.

Unfortunately, fish will move freely across such jurisdictional boundaries, and fishing boats licensed in districts and provinces will fish outside those areas. These attempts at separation of resources will work in some cases, but in many cases they will fail. There are also additional problem of boats over 30 GT being licensed at the district or provincial level because it is cheaper, or more convenient, to do so.

Local marine resource regulations have been created within most provinces and districts. Some examples are provided in recent reports (e.g. Anon 2005e), are available at appropriate offices, or in some cases on the world wide web. In some areas these regulations are concerned primarily with taxation of fishery products and businesses, and related licensing, but other local regulations concern fishing, and vessel, restrictions. As reported in Anon (2005e) many respondents pointed out difficulties in coordinating and enforcing national and local regulations.

Consequently, management of migratory and widespread resources in a decentralized Indonesia will require *better coordination than in the past*. The means of achieving this coordination can be through the existing national and regional fishery coordination councils (see section 2.3.1). If this is to happen, the abilities of these councils must be strengthened.

At present provincial and district governments have limited research facilities for carrying out stock assessment or other resource assessment work. Ability to understand and manage marine resources is also limited. This may change as

university and provincial research and management offices improve. However, for the time being, it is likely that national research programs and personnel will retain responsibility for resource assessments within each fishery management area. It also seems appropriate that these same national agencies should have *primary* responsibility for determining the *total allowable catch* for each specific fishery (or appropriate harvest levels for other resources) within each resource management area. Nevertheless, determination of the total allowable catches, or other harvest arrangements, should be carried out in cooperation with selected provincial and district stakeholders who should have a *secondary* responsibility at this time. In the future it is likely that assessment of strictly local resources, and setting of catch levels, and allocations, for those, will be done at the provincial level. In special cases, for appropriate types of resources, the district or community level assessments may be appropriate.

Even today, however, it is appropriate that the *allocation of catches* among the different stakeholders be carried out with full participation of provincial and district stakeholders. Such allocation should be discussed within the each appropriate fishery coordination councils. The means of allocation should be transparent and open to discussion but should be based on good resource assessments. If resource assessments are limited then only very careful harvest should be permitted and allocation of the lowered catch will be difficult.

Ultimately the above assessment, setting of allowable catches, and allocation of allowable catch to the fishery participants will be carried out within the framework of fishery management plans.

> NEEDED: A clarification of the roles of different levels of government, and support for those roles within a new management paradigm. This clarification must include 1)determination of responsibilities for research, 2)assignment of authority and methods for setting total allowable catch for each fishery, and 3)equitable procedures and responsibilities for allocating catches among stakeholders.

3.7.1.2 How can decentralization and co-management improve fishery management?

One weakness of a national fishery management infrastructure is that people living in Jakarta may out of touch with the day to day management realities in the field, at the fishing ports, on the boats, and in the village. A major *theoretical* advantage of decentralized management is that managers will be more aware of these on-the-ground perceptions. In reality, things may be different. Provincial administrators may be no closer to the reality of life in a fishing community than their counterparts in Jakarta. Problems of transparency and accountability may be no better at the provincial level, and might even be worse. There is *no guarantee* that decentralization will deliver better management.

Nevertheless, at the province and district level fisheries personnel *can be* closer to the fishing activity and its participants, and to other marine resource issues. The *challenge* is: how can the theoretical advantages of decentralization be made real.

Ideally the granting of authority over resource management should be linked to an ability and a commitment to implement good resource management. This can be said for *both* the local and the national level. But such provisional granting of authority is not possible; decentralization is already a reality. Consequently, the role of national, provincial, district, and local stakeholders is to assist each other in working to better manage marine and fishery resources. To do this each level of authority should work to improve its own strengths and to help improve the complementary strengths of the others.

Applying this *philosophy of decentralized cooperation,* districts would work with local stakeholders to ensure that their knowledge and desires are heard at higher levels. National agencies would use their knowledge of broader issues to provide districts with a better, big picture, view of resource management issues. For such as system to work better communication, coordination, and understanding at all levels is essential.

> NEEDED: A move away from the *structural* command and control view of the past to a new system where each level of government improves the *functional* aspects the services it provides to the country and community. Emphasis should be on the provision of services and the *quality* of those services. From

a resource management perspective these services should 1) improve the knowledge of resources, should 2) help develop management approaches for those resources, and should 3) help implement that management.

3.7.2 Make better use of co-management and "Community" based management

3.7.2.1 Background

The concepts of co-management and community based management have been popular for many years. Co-management involves specific government participation in the management process, while community based management has no, or very limited, government participation (Pomeroy and Berkes 1997). Interest in these management options is high because they have potential, *under the right*

Table 2. Table 3. Some design principles for common pool resources (based on (Ostrom 1990)

	Ten Basic Requirements for Successful Community Management of Common Pool Resources
1	The resource under management must have clearly defined boundaries
2	People who use the resource are clearly defined
3	People using the resources have a local arrangement for making their own choices about the those resources
4	Rules and regulations are appropriate for the resources being managed
5	Users have the responsibility for monitoring and enforcement
6	Sanctions apply for violating regulations
7	Formal conflict resolution mechanisms are available to resource users
8	The resource users right to organize is legally recognized
9	A nested organization allows rules and regulations at different levels
10	There is good coordination between government and community

circumstances, to significantly improve resource management outcomes and reduce monetary costs.

Ostrom (1990) described key conditions necessary for creation of successful management institutions for common pool resource, including fisheries (Table 3). These conditions, or principles, have now been widely used in describing a number of natural resource management situations, including those pertaining to fisheries and marine resources (Dudley et al. 2000, Noble 2000, Pomeroy et al. 2001, Brown et al. 2005). Some workers (e.g. Pomeroy et al. 2001) have extended these principles to include more issues related to resource co-management (Table 4).

There are a number of well researched case studies within Indonesia and Southeast Asia (e.g. Purnomo 1997?, Harkes 1999, Elliott et al. 2001, Novaczek et al. 2001, Clifton 2003, Erdman et al. 2004) which point out the strengths and, in some cases, limitations of traditional management systems. Recent projects have also emphasized community based co-management approaches (e.g. USAID 2002, Tighe 2005). A large number of co-management studies in fisheries, and other fields have been carried out by the Consultative Group on International Agricultural Research (CGIAR) System-wide Program on Collective Action and Property Rights (CAPRi). (See http://www.capri.cgiar.org/capri.htm). Almost all examples, and projects, of this sort, have emphasized the management of place-based, fixed, resources (e.g. coral

Table 4. Some conditions which improve the likelihood of successful co-management of fishery resources. (from Pomeroy et al. 2001).

Conditions affecting the success of fisheries co-management
Supra-community level
Enabling policies and legislation
External agents – can assist the community
Community level
Appropriate scale and defined boundaries
Membership is clearly defined
Group homogeneity – makes management easier and reduces conflict
Participation by those affected
Leadership
Empowerment, capacity building, and social preparation
Community organizations
Long-term support of the local government unit
Property rights over the resource
Adequate financial resources/budget
Partnerships and partner sense of ownership of the co-management process
Accountability
Conflict management mechanism
Clear objectives from a well-defined set of issues
Individual and household level
Individual incentive structure – incentive to participate

reefs, forests) which are ideal from the perspective of some of the co-management design principles, especially the principle that the co-managed resource must have clearly defined boundaries.

Other types of marine resources, especially fishery resources, do not have clear boundaries, and special efforts need to be made to define the boundaries. Again, as indicated in section 3.5, resource boundaries are not only geographical, but can be ecological, or can be related to participation in a particular type of fishery. Consequently, the definition of a co-management "community" needs to be extended beyond the idea of a village or other fixed location (see 3.7.2.2).

3.7.2.2 Co-management, communities and external programs

In recent years local management, community management, and co-management arrangements have been widely proposed as solutions for various natural resource management problems. The existence of many externally funded projects promoting local management forces one to reconsider the true role and potential of locally based management. There are two questions to be addressed here: the true potential of local / community management, and the current role of such management given the extent of *external interest* in it.

This is a troubling aspect of current community based management efforts in Indonesia: some traditional systems have been co-opted by top down, government sponsored, processes. Although these projects are located within participating communities, they are organized and controlled via government agencies at either the district, province or national level (usually all three). Many examples of such processes are found in externally funded projects, which may create *de facto* management from the center.

Nevertheless, some, perhaps many, marine resource situations in Indonesia require more than community based management. In many cases a co-management approach is necessary. Nevertheless, the local community components of co-management approaches should be truly local in nature.

> NEEDED: Techniques to develop, and improve, locally based management systems, including traditional ones, and local participation in larger

management systems, without creating unnecessary dependence on various levels of government and external funding. The long term goal is to have community based components truly local, supported, and funded, by the fishery participants including dependent businesses.

3.7.2.3 Transaction costs of co-management

Transaction costs associated with co-management also need to be considered. Although enforcement and other management costs of local or co-managed resources may be lower, careful consideration needs to be to the financial and other costs including the time needed for discussions, negotiation, and other activities associated with co-management (Azhar et al. 1999). If the time needed for these activities is not considered in planning, participants and managers may both feel that co-management is nothing but talk with no results. Careful planning requires sufficient consideration of these transaction costs. Doing so will help ensure that discussions will lead to action.

3.7.2.4 Communities, stakeholders and domain experts

A well developed community is something more than a collection of individuals. Jentoft (1998) has concluded that a viable community is essential for viable fish stocks. Not only are communities dependent on fish stocks, but fish stocks are dependent on viable communities that manage their resources carefully. *Over-fishing is a sign of community failure*. The maintenance of viable communities is an essential part of fishery management. The institutions within communities, both formal and informal, create a cohesive force that can, under the right circumstances solve many shared problems.

Other community management strengths are related to local knowledge derived from the experiences of the fishermen and other resource users. However, local, traditional, resource management arrangements should not automatically be accepted and institutionalized. It is possible to misinterpret current local rules and regulations as something fixed. In some, perhaps most, cases local management *systems* are not fixed rules but are *systems* for developing temporary agreements regarding resource use. These may gradually become custom. Local management arrangements of this type are the local equivalent of fishery management plans, rather than a set of fixed rules (Frost 2004).

Also, in some areas, it is possible that traditional management has favored certain groups at the expense of others. In such cases there could be a danger of officially condoning inequalities based on local tradition (Frost 2004). Modern co-management should strive to ensure the inclusion of human ideals, such as equality, within the management programs.

Co-management stimulates shared learning, and that learning is an important part of management. These shared experiences can lead to experimental approaches whereby participants agree to try a new management actions to see what happens. This adaptive learning is a powerful tool available within the co-management approach (Garaway and Arthur 2004).

There is also the question of who is a *stakeholder*. Stakeholders are not necessarily just community members who fish. A stakeholder is someone who has an interest in a marine resource, and might include tourists, business operators, fishermen or other distant or nearby participants. Nowadays it is not sufficient to only involve local resource users in fishery management, since there are other stakeholders with legitimate interests. The several approaches for the identification of genuine stakeholders have been proposed (e.g. Colfer 1995, Mikalsen and Jentoft 2001)

All stakeholders will have a knowledge of their own interests, be it business, fishing techniques, or something else. Only a few, and perhaps none, will have a detailed knowledge of the resource itself. Nevertheless, *domain experts* are critical sources of information in a co-management system. Every stakeholder is a *potential* domain expert – a person having detailed knowledge about some aspect of the resource and its exploitation. Also, some domain experts may not be stakeholders. For example a scientist knowledgeable about shrimp may have no personal interest in a shrimp fishery. Nevertheless, it would be of use to have such people play a role in a co-management system, and means of doing that should be considered. There needs to be a method of identifying true domain experts and holders of traditional knowledge.

> NEEDED: A means of making true progress on the issue of co-management of key resources beyond the fixed area approach. Means of defining all stakeholders, and other management participants need to be developed for the Indonesian situation. Full participation of all stakeholders in developing

realistic, successful, co-management programs is one of the major challenges, and opportunities, of decentralization. Also of critical importance in the development of means of accurately monitoring the practical social and ecological outcomes of these management approaches,

3.7.2.5 Redefined, community co-management within a larger framework

Community-based management has been a popular approach to improve management of natural resources, particularly in areas where standard enforcement approaches are not working. In some cases a "village" or physical community is a suitable basis for such management, but for many marine resources *the idea of community will need to be redefined*. The role of participatory management is important, not only within the traditional definition of community, but within the larger concept of a fishing community that includes all stakeholders: fishermen, traders, fish processors, even large scale fisheries interests when appropriate. Unless all stakeholders are included in local or co-management arrangements, the arrangement will fail. For effective co-management, Indonesia needs to redefine "communities" – not just as a village or location but as groups of resource users *and* other stakeholders (Allison and Ellis 2001).

For example, migratory fishes and other wide ranging resources, move in and out of a physical village or district area, perhaps every day, or seasonally. These resources are subject to fishing elsewhere. Without wider coordination resource damage (over-fishing) can still occur. For most reef fisheries area based management can work. But for migratory or widespread resources the definition of "community" must change.

Also, marine resources belong to the people of Indonesia. Many resources perceived as local actually have regional components. The role of community management, though important, must be applied carefully. Locally based management within a broader framework seems appropriate especially where external stakeholders exist. The implementation of such nested management systems requires a clear framework specifying the allocation of rights and responsibilities (see also Section 1.3.2.2).

NEEDED: The development of a nested management system, incorporated into fishery management planning and law, whereby clear roles of national,

provincial, district and local stakeholders is defined. Rights and responsibilities of all stakeholders and resource participants needs to be clarified.

3.8 Optimize international fishery opportunities

3.8.1 Tuna fisheries

Indian ocean tuna fisheries have expanded rapidly and are fully exploited at present. High catches in 2003 will not be maintained and catch is expected to drop (IOTC 2005) for the next few years. Also, fishing grounds are now far from Indonesian ports, and fuel prices have risen. For these reasons increases in catches for Indonesian vessels appears unlikely. Nevertheless, it is in Indonesia's best interest to work closely with the Indian Ocean Tuna Commission so that, in the long run, Indonesia is a full player in the international management of, and harvest from, that resource - especially yellowfin and bigeye tuna.

Southern Bluefin Tuna is an extremely high value species that enters Indonesia's southern waters. Indonesian boats also catch this species when fishing outside Indonesia's territorial waters to the south. This species is managed by the Committee for the Conservation of Southern Bluefin Tuna. This committee agreed that a catch limit not exceeding 800 tons would be appropriate for Indonesia if Indonesia became a cooperating non-member, or a member.

At present the Southern Bluefin Tuna Stock is overfished and is much below the level that would produce an optimal yield. This tuna stock will remain this way into the near future, and recovery plans have been proposed (CCSBT 2005). Recovery to optimal stock size will likely take tens of years, although fishing can occur during this period.

Because of 1) the high value of this species, 2) the fact that the stock is near or within Indonesian waters, and 3) the location of the spawning ground partly within Indonesian waters, it would be good policy, for both the long and short term, for Indonesia to fully cooperate with the committee's management efforts. A policy of full cooperation will assure that Indonesia receives its legal share of the catch of this highly valuable species. This would also allow Indonesia to use the expertise of the committee in setting Indonesian policies for this and other, related, species.

Skipjack tuna (cakalang) area abundant in eastern Indonesia. This species has a high growth rate, is short lived (up to 4 years old) and highly fecund. Reproductive success is highly variable and is dependant on oceanographic conditions. These characteristics create a very productive, but variable fishery. Although skipjack are known to migrate thousands of miles, there are some indications that some stay within a relatively restricted area for extended periods. Migrations appear to be linked to oceanographic conditions.

Because of the link of recruitment and migration to oceanographic conditions, this species may present the possibility for investigating the use indices of abundance of juveniles and the oceanographic conditions that produced them, to predict fishing success one to two years into the future. These oceanographic conditions are monitored by satellite and Indonesia has access to these data. Indonesia should continue to improve this ability and should work with bilateral and international agencies to improve prediction capabilities.

3.8.2 Tuna management issues

The tuna long-line fleet in Indonesia is overcapitalized. In the past, high productivity of the Indian Ocean fishery, and fuel subsidies, encouraged the entrance of more long-line vessels into the fishery. Now, dropping catches, and higher fuel price has caused these boats to fish nearer to Indonesia putting a higher fishing pressure on fish stocks in Indonesia. This fleet, developed for fishing over a wide area, is now fishing in a comparatively small area. This is a difficult management situation that *could have been avoided*.

Illegal fishing in Indonesian waters causes a major loss of income for Indonesian skipjack fishermen especially in the South China Sea and Pacific Ocean fishery management areas. Further information on the important issue of illegal and unreported fishing is included in the project report on that subject (Sarti 2006).

These species of tuna (yellowfin, bigeye, southern bluefin, skipjack) cannot be managed by Indonesia alone. These are shared stocks requiring international cooperation.

> NEEDED: Enhanced participation in international tuna management organizations in order to ensure Indonesia's full participation in the management and benefits of these fisheries.

3.8.3 Improve use of international funding

At present there appears to be large amounts of overlap among fishery projects, considerable repetition of project goals over time, and an emphasis on large projects with small returns. Many projects, regardless of name, are still providing old style funding for fishery development initiatives. However, further development of Indonesia's fisheries is more likely to be attained by better, and more careful management. This implies a need for more careful attention as to how money is actually spent, and a better monitoring of true outcomes of externally funded projects. As a first step toward fulfilling this need a reassessment of actual outcomes of past projects is needed.

There may be legitimate reasons for the approaches currently in place, but one result has been that projects tend to fund general operations of the executing institutions, rather than leading to innovative new solutions to long-standing problems. This leads to a situation whereby these potential executing agencies, and their sub-components, compete for projects in order to gain core funding rather than to provide meaningful results. Also, projects in inappropriate agencies merely confuse the difficult task of fishery management, and leads to the inefficient use of time and money.

Ideally projects should be carried out in a cooperative manner with roles of appropriate agencies clearly defined.

> NEEDED: Improved approaches for project conception, planning, and execution are needed. Innovative cooperative and transparent approaches should help to ensure that funding is used strictly for project activities, and that projects are focused on the goals of providing better fishery management and more productive fisheries. Such improvements should include the creation of enhanced, external, project monitoring and evaluation processes.

4 LITERATURE CITED

Abesamis, R. A., and G. R. Russa. 2005. Density-dependent spillover from a marine reserve: Long-term evidence. Ecological Applications **15**:1798–1812.

Allison, E. H., and F. Ellis. 2001. The livelihoods approach and management of small-scale fisheries. Marine Policy **25**:377-388.

Allison, G. W., S. D. Gaines, J. Lubchenco, and H. P. Possingham. 2003. Ensuring persistence of marine reserves: Catastrophes require adopting an insurance factor. Ecological Applications **13**:S8.

Anon. 2000. Reducing the impact of tropical shrimp trawling fisheries on living marine resources through the adoption of environmentally friendly techniques and practices in the arafura sea, Indonesia. *in* F. I. D. Fishery Technology Service, FAO Fisheries Department, editor. Tropical shrimp fisheries and their impact on living resources. FAO, Rome.

Anon. 2005a. Pengembangan awal program observer di kapal laporan akhir (development of a preliminary on-board observer program, final report). Direktorat Jenderal Perikanan Tangkap, Departemen Kelautan dan Perikanan, Jakarta.

Anon. 2005b. Rencana pengelolaan perikanan kawasan teluk saleh kabupaten Dompu Nusa Tenggara Barat. Marginal Fishing Community Development Project (MFCDP).

Anon. 2005c. Statistik perikanan tangkap Indonesia, 2003. Departemen Kelautan dan Perikanan, Direktorat Jenderal Perikanan Tangkap, Jakarta.

Anon. 2005d. Statistik produksi perikanan laut berdasarkan wilayah pengelolaan perikanan (wpp), 1999-2003. Departemen Kelautan dan Perikanan, Direktorat Jenderal Perikanan Tangkap, Jakarta.

Anon. 2005e. The study on the current Indonesian fisheries scheme under the decentralization: Final report volume i. PT Pacific Consulindo International Indonesia & Japan International Cooperation Agency, Jakarta.

Azhar, A. K. M., N. M. R. Abdullah, and K. K. Viswanathan. 1999. Transaction costs in fisheries co-management: A comparative statics framework. *in* International Workshop on Fisheries Co-management. ICLARM.

Badrudin, and Wudianto. 2004. Biologi, habitat dan sebaran ikan layur serta beberapa aspek perikanannya. Pages 15 *in* Workshop Rencana Pengelolaan Perikanan Layur. Dinas Kelautan dan Perikanan Kabupaten Trenggalek / Co-Fish Project. Balai Riset Perikanan Laut Jakarta PRPT-BRKP-DKP Cofish, Kediri.

Blaber, S., C. Dichmont, R. Buckworth, Badrudin, B. Sumiono, S. Nurhakim, B. Iskandar, B. Fegan, D. Ramm, and J. Salini. 2005. Shared stocks of snappers (lutjanidae) in Australia and Indonesia: Integrating biology, population dynamics and socio-economics to examine management scenarios. Reviews in Fish Biology and Fisheries **15**:111-127.

Blaber, S. J. M., D. T. Brewer, D. A. Milton, G. S. Merta, D. Efizon, G. Fry, and T. v. d. Velde. 1999. The life history of the protandrous tropical shad Tenualosa macrura (alosinae: Clupeidae): Fishery implications. Estuarine, Coastal and Shelf Science **49**:689–701.

Brewer, D. T., S. J. M. Blaber, G. Fry, G. S. Merta, and D. Efizon. 2001. Sawdust ingestion by the tropical shad (Tenualosa macrura, Teleostei: Clupeidae): Implications for conservation and fisheries. Biological Conservation **97**:239-249.

Brown, D., D. Staples, and S. Funge-Smith. 2005. Mainstreaming fisheries co-management in Asia-Pacific. Pages 26 *in* APFIC Regional Workshop on Mainstreaming Fisheries Co-management in Asia-Pacific, Siem Reap, Cambodia.

Buchary, E. A., J. Alder, S. Nurhakim, and T. Wagey. 2002. The use of ecosystem-based modelling to investigate multi-species management strategies for capture fisheries in the Bali Strait, Indonesia. Pages 24-32 *in* T. Pitcher and K. Cochrane, editors. The use of ecosystem models to investigate multispecies management strategies for capture fisheries. The Fisheries Centre, University of British Columbia, Vancouver.

Caddy, J. F. 2002. Limit reference points, traffic lights, and holistic approaches to fisheries management with minimal stock assessment input. Fisheries Research **56**:133-137.

Caddy, J. F., and R. Mahon. 1995. Reference points for fisheries management. FAO Fisheries Technical Papers - T347, FAO, Rome.

CCSBT. 2005. Report of the sixth meeting of the stock assessment group. Commission for the Conservation of Southern Bluefin Tuna, Canberra, Australia.

Clifton, J. 2003. Prospects for co-management in Indonesia's marine protected areas. Marine Policy **27**:389-395.

Cochrane, K. L. 1999. Complexity in fisheries and limitations in the increasing complexity of fisheries management. ICES Journal of Marine Science **56**:917–926.

Cochrane, K. L., editor. 2002. A fishery manager's guidebook: Management measures and their application. FAO, Rome.

Colfer, C. J. P. 1995. Who counts most in sustainable forest management? Working Paper No. 7, Center For International Forestry Research, Bogor, Indonesia.

Collie, J. S., and H. Gislason. 2001. Biological reference points for fish stocks in a multispecies context. Canadian Journal of Fisheries and Aquatic Sciences **58**:2167-2176.

Currie, D. 2006. Technical report no 5a: Environment. Marine and Fisheries Sector Strategy Study (ADB TA 4551 - INO), Prepared by Uniconsult International Limited (UCIL), Jakarta.

Dahl, A. L. 2000. Using indicators to measure sustainability: Recent methodological and conceptual developments. Marine and Freshwater Research (Special Issue: Sustainability Indicators in Marine Capture Fisheries) **51**:427–433.

Dahuri, R. 2001. Decentralizing and delegating ICM to regional and local communities: A precarious balance of authority, capacity and consistency.

Pages 19 *in* UNESCO Oceans and Coasts Pre-World Summit on Sustainable Development Conference, Paris, France.

Die, D. J. 2002. Chapter 9: Design and implementation of management plans. Pages 231 *in* K. L. Cochrane, editor. A fishery manager's guidebook: Management measures and their application. FAO, Rome.

Die, D. J., and J. F. Caddy. 1997. Sustainable yield indicators from biomass: Are there appropriate reference points for use in tropical fisheries? Fisheries Research **32**:69-79.

Direktorat Kelembagaan Internasional. 2003. Strategi nasional implementasi code of conduct for responsible fisheries. Departemen Kelautan dan Perikanan, Jakarta.

Dudley, R. G. 2003. A basis for understanding fishery management complexities. Pages 27 *in* the International Conference of the System Dynamics Society, New York. see http://pws.prserv.net/RGDudley/dudspbs.html.

Dudley, R. G., T. Nurhidayati, H. Pamungkas, and T. N. Cahyo. 2000. Segara Anakan fisheries management plan. Consultant's Report Segara Anakan Conservation and Development Project Components B & C. see http://pws.prserv.net/RGDudley/dudspbs.html.

Durand, J. R., and J. Widodo. 1995a. The Java Sea ecosystem. Pages 319-324 *in* J. Roch, S. Nurhakim, J. Widodo, and A. Poernomo, editors. SOSEKIMA Proceedings of Socio-economic, Innovation and Management of the Java Sea Pealgic Fisheries. Java Sea Pelagic Fishery Assessment Project, Bandungan, Central Java, Indonesia.

Durand, J. R., and J. Widodo. 1995b. Preliminary considerations for the management of the small pelagic fisheries of the Java Sea. Pages 319-324 *in* J. Roch, S. Nurhakim, J. Widodo, and A. Poernomo, editors. SOSEKIMA Proceedings of Socio-economic, Innovation and Management of the Java Sea Pealgic Fisheries. Java Sea Pelagic Fishery Assessment Project, Bandungan, Central Java, Indonesia.

Elliott, G., B. Mitchell, B. Wiltshire, I. Abdul Manan, and S. Wismer. 2001. Community participation in marine protected area management: Wakatobi National Park, Sulawesi, Indonesia. Coastal Management **29**:295-316.

Erdman, M. V., P. R. Merrill, M. Mongdong, I. Arsyad, Z. Harahap, R. Pangalila, R. Elverawati, and P. Baworo. 2004. Effective decentralised co-management of Bunaken National Park, Indonesia. Natural Resources Management Program.

Evans S.M, Gill M.E, Retraubun A.S.W, Abrahamz J, and Dangeubun J. 1997. Traditional management practices and the conservation of the gastropod (Trochus nilitocus) and fish stocks in the Maluku Province (eastern Indonesia). Fisheries Research **31**:83-91(89).

FAO. 1995. Code of conduct for responsible fisheries. FAO, Rome.

FAO/FISHCODE. 2001. Report on a workshop to refine the draft management plan for the Bali Strait (lemuru) fishery. GCP/INT/648/NOR Field Report F-18 (En), FAO, Banyuwangi (East Java), Indonesia.

Fogarty, M. J., and S. A. Murawski. 1998. Large-scale disturbance and the structure of marine systems: Fishery impacts on Georges Bank. Ecological Applications **8**:S6-S22.

Fromentin, J. M., A. Fonteneau, and H. Farrugio. 1999. Biological reference points and natural long-term fluctuations: The case of the eastern Atlantic bluefin tuna. SCRS/99/054 ICCAT.

Frost, N. 2004. Adat in Maluku: New value or old exclusions? ANTROPOLOGI INDONESIA **Special Volume**:1-10.

Garaway, C. J., and R. I. Arthur. 2004. Adaptive learning: A practical framework for the implementation of adaptive co-management— lessons from selected experiences in south and southeast Asia. MRAG Ltd. London, London.

Garcia, S. M., and D. Staples. 2000a. Sustainability indicators in marine capture fisheries: Introduction to the special issue. Marine and Freshwater Research (Special Issue: Sustainability Indicators in Marine Capture Fisheries) **51**:381-384.

Garcia, S. M., and D. Staples. 2000b. Sustainability reference systems and indicators for responsible marine capture fisheries: A review of concepts and elements for a set of guidelines. Marine and Freshwater Research (Special Issue: Sustainability Indicators in Marine Capture Fisheries) **51**:385-426.

Garcia, S. M., A. Zerbi, C. Aliaume, T. Do Chi, and G. Lasserre. 2003. The ecosystem approach to fisheries. Issues, terminology, principles, institutional foundations, implementation and outlook. FAO Fisheries Technical Paper 443, FAO, Rome.

Ghofar, A. 1996. Cephalopod resource of west nusatenggara, with notes on probable causes of their depletion. *in* UNESCO/IOC-WESTPAC International Symposium on Integrated Approaches to Coastal Management, Bali.

Ghofar, A. 2002. Interactions of squid and small-pelagic resources in the alas strait, Indonesia. Journal of Coastal Development **6**:23-32.

Ghofar, A. 2002? Marine fisheries management plan in Indonesia – a case study of the Bali Strait fishery. Universitas Diponogoro, Semarang.

Ghofar, A. 2005. ENSO effects on the Alas Strait squid resource and fishery. Indonesian Journal of Marine Science **10**:106-114.

Ghofar, A., C. P. Mathews, G. S. Merta, and S. Salim. 1999. Incorporating the southern oscillation indices to the management model of the Bali Strait sardinella fishery. Pages 43-52 *in* FAO/DGF Workshop on the Management of Oil Sardine fishery in the Bali Strait, Bali.

Gilbert, D. J., J. H. Annala, and K. Johnston. 2000. Technical background to fish stock indicators for state-of-environment reporting in New Zealand. Marine and Freshwater Research (Special Issue: Sustainability Indicators in Marine Capture Fisheries) **51**:451-464.

Gillett, R. 1996. Marine fisheries resources and management in Indonesia with emphasis on the extended economic zone. *in* DGF/FAO Workshop on Strengthening Marine Resource Management in Indonesia, Jakarta.

Hanson, A. J., I. Augustine, C. A. Courtney, A. Fauzi, S. Gammage, and Koesoebiono. 2003. Proyek Pesisir an assessment of the coastal resource management project (CRMP) in Indonesia. Final Report The government of indonesia, usaid, implemented by the coastal resources center, university of rhode island.

Harkes, I. 1999. An institutional analysis of sasi laut, a fisheries management system in Indonesia. *in* Proceedings of the International Workshop on Fisheries Co-management.

Hofmann, E. E., and T. M. Powell. 1998. Environmental variability effects on marine fisheries: Four case histories. Ecological Applications **8**:S23-S32.

Holland, D. S. 2002. Integrating marine protected areas into models for fishery assessment and management. Natural Resource Modeling **15**:369-386.

Holland, D. S., and R. J. Breeze. 1996. Marine reserves for fisheries management. Marine Resource Economics **11**:157-171.

IOTC. 2005. Report of the seventh session of the IOTC working party on tropical tunas. IOTC-2005-WPTT-R[EN], Indian Ocean Tuna Commission, Phuket, Thailand.

Jentoft, S., B. J. McCay, and D. C. Wilson. 1998. Social theory and fisheries co-management. Marine Policy **22**:423-436.

Klyashtorin, L. B. 2001. Climate change and long-term fluctuations of commercial catches, the possibility of forecasting. FAO Fisheries Technical Paper 410, FAO, Rome.

Lauck, T., C. W. Clark, M. Mangel, and G. R. Munro. 1998. Implementing the precautionary principle in fisheries management through marine reserves. Ecological Applications **8**:S72-S78.

Marin, J. 1999? Annex 8: A review of some reference points for fisheries management. Stock assessment Sub Committee of the SAC/CGPM.

Marsh, H., H. Penrose, C. Eros, and J. Hughes. 2002. Dugong status report and action plan for countries and territories. Early Warning and Assessment Report Series UNEP/DEWA/RS.02-1, UNEP.

McElroy, J. K. 1991. The Java sea purse seine fishery a modern-day 'tragedy of the commons'? Marine Policy **15**:255-271.

McKenna, S., G. R. Allen, and S. Suryadi. 2002. A marine rapid assessment of the Raja Ampat Islands, Papua Province, Indonesia. Conservation International, Washington.

Mikalsen, K. H., and S. Jentoft. 2001. From user-groups to stakeholders? The public interest in fisheries management. Marine Policy **25**:281-292.

Mous, P. J., J. S. Pet, Z. Arifin, R. Djohani, M. V. Erdmann, A. Halim, M. Knight, L. Pet-Soede, and G. Wiadnya. 2005. Policy needs to improve marine capture fisheries management and to define a role for marine protected areas in Indonesia. Fisheries Management and Ecology **12**:259-268.

Mous, P. J., Y. Sadovy, A. Halim, and J. S. Pet. 2006. Capture for culture: Artificial shelters for grouper collection in SE Asia. Fish and Fisheries **7**:58–72.

Muhammad, S. 2004. Pembentukan management body perikanan layur dan rencana implimentasi pengelolaan. *in* Workshop-2 Rencana Pengelolaan Perikanan Layur. Kerjasama COFISH dan Dinas Kelautan dan Perikanan Trenggalek, Kediri.

Murphy, E. J. 1995. Spatial structure of the southern ocean ecosystem: Predator-prey linkages in southern ocean food webs. Journal of Animal Ecology **64**:333-347.

Noble, B. F. 2000. Institutional criteria for co-management. Marine Policy **24**:69-77.

Novaczek, I., I. H. T. Harkes, J. Sopacua, and M. D. D. Tatuhey. 2001. An institutional analysis of sasi laut in Maluku, Indonesia. ICLARM Tech. Rep 59, ICLARM-The World Fish Center, Penang, Malaysia.

Ostrom, E. 1990. Governing the commons : The evolution of institutions for collective action. Cambridge University Press, Cambridge England ; New York.

Pasaribu, B. P., D. Manurung, and D. Nugroho. 2004. Fish stock assessment using marine acoustics detection and oceanographical characteristics in Java Sea. Gayana (Concepc.) **68**:466-475.

Patlis, J. M., R. Dahuri, M. Knight, and J. Tulungen. 2001. Integrated coastal management in a decentralized Indonesia: How it can work. Pesisir and Lautan **4**.

Pauly, D., V. Christensen, J. Dalsgaard, R. Froese, and F. T. Jr. 1998. Fishing down marine food webs. Science **279**:860-863.

Pet-Soede, C., W. L. T. van Densen, J. S. Pet, and M. A. M. Machiels. 2001. Impact of Indonesian coral reef fisheries on fish community structure and the resultant catch composition. Fisheries Research **51**:35-51.

Pomeroy, R. S., and F. Berkes. 1997. Two to tango: The role of government in fisheries co-management. Marine Policy **21**:465-480.

Pomeroy, R. S., B. M. Katon, and I. Harkes. 2001. Conditions affecting the success of fisheries co-management: Lessons from Asia. Marine Policy **25**:197-208.

Prabhu, R., C. J. P. Colfer, and R. G. Dudley. 1999. Guidelines for developing, testing & selecting criteria and indicators for sustainable forest management: A C&I developer's reference. Center for International Forestry Research, Bogor, Indonesia.

Purnomo, A. H. 1997? Refashioning sasi, a community based management system in eastern Indonesia. *in* International Symposium on Protection and Management of Coastal Marine Ecosystem.

Purwaka, T. H., and Sunoto. 2001. Coastal resources management in Indonesia: Legal and institutional aspects. Pages 60-90 *in* M. Torell and A. M. Salamanca, editors. ICLARM - The World Fish Center, Penang (Malaysia).

Roberts, C. M., and H. Sargant. 2002. Fishery benefits of fully protected marine reserves: Why habitat and behavior are important. Natural Resource Modeling **15**.

Robinson, L. A., and C. L. J. Frid. 2003. Dynamic ecosystem models and the evaluation of ecosystem effects of fishing: Can we make meaningful predictions? Aquatic Conservation: Marine and Freshwater Ecosystems **13**:5-20.

Roch, J., S. Nurhakim, J. Widodo, and A. Poernomo, editors. 1998. Sosekima proceedings of socio-economic, innovation and management of the Java sea pealgic fisheries. Java Sea Pelagic Fishery Assessment Project, Bandungan, Central Java, Indonesia.

Rossiter, W. W. 1997? Fisheries conservation crisis in Indonesia massive destruction of marine mammals, sea turtles and fish reported from trap nets in pelagic migratory channel. *in*. Cetacean Society International. http://www.dbc.uci.edu/~sustain/bio65/indonesia/indon97e.htm.

Sadovy, Y., M. Kulbicki, P. Labrosse, Y. Letourneur, P. Lokani, and T. J. Donaldson. 2003. The humphead wrasse, Cheilinus undulatus: Synopsis of a threatened and poorly known giant coral reef fish. Reviews in Fish Biology and Fisheries **13**:327-364.

Sarti, N. 2006. Technical report no 2: Monitoring, control and survailance. Marine and Fisheries Sector Strategy Study (ADB TA 4551 - INO). Prepared by Uniconsult International Limited (UCIL), Jakarta.

Satria, A., and Y. Matsuda. 2004. Decentralization of fisheries management in Indonesia. Marine Policy **28**:437-450.

Sondita, F. A. 2004. Monitoring pengelolaan dan pemanfaatan sumberdaya ikan. *in* Workshop-2 Rencana Pengelolaan Perikanan Layur. Kerjasama COFISH dan Dinas Kelautan dan Perikanan Trenggalek, Kediri.

Squires, D., I. H. Omar, Y. Jeon, J. Kirkley, K. Kuperan, and I. Susilowati. 2003. Excess capacity and sustainable development in Java sea fisheries. Environment and Development Economics **8**:105-127.

Stobutzki, I. C. 2000. Marine reserves and the complexity of larval dispersal. Reviews in Fish Biology and Fisheries **10**:515-518.

Tighe, S. A., editor. 2005. Advances and lessons learned in coastal governance in Indonesia: Experience from USAID's coastal resources management project II 2003-2005. Coastal Resources Management Project, Jakarta, Indonesia.

Unar, M., and N. Naamin. 1984. A review of the Indonesian shrimp fisheries and their management. *in* Penaeid shrimps - their biology and management. Fishing News Books Ltd.

USAID. 2002. Final report of the Indonesia natural resources management II program task order: Decentralized and strengthened natural resources management in Indonesia. IRG.

Widodo, J., and J.-R. Durand. 1997. Java Sea pelagic fisheries assessment project issues final report. *see:* europa.eu.int/comm/development/body/publications/fish/pe069719.pdf.

Widodo, J., N. N. Wiadnyana, D. Nugroho, and (eds). 2003. Prosiding forum pengkajian stok ikan laut di perairan Indonesia. Pages 99 *in*. Pusat riset perikanan tangkap, Badan reset kelautan dan perikanan, Departemen kelautan dan perikanan, Jakarta.

Yndestad, H. 2003. The code of the long-term biomass cycles in the barents sea. ICES Journal of Marine Science **60**:1251-1264.

APPENDIX 1 – SUMMARY OF NEEDS

This is a restatement of "needed" items as stated in the text. Each Need is linked to one or more concept notes in Appendix 2. Several needs may be addressed by the same concept note.

1) Better support for all Indonesian scientists (at government agencies, universities and the non-governmental / private sector) to access and use new information resources. This support should include actions, and equipment acquisition, to improve computer communications and web access from all offices, and should provide training in such technologies where appropriate. This support should also improve links (and build on existing ones) among marine resource workers in different ministries, local government, and communities where possible, and the private sector. Incentives should be provided for personnel to improve English language abilities and opportunities to visit international fishery research and, especially, management, facilities. Concept Note: **Enhancement of Fishery Management Capabilities**

2) A reexamination of the professional requirements at the district and provincial fishery offices in light of the additional technical responsibilities devolved to those offices assignments. Professional staff need to be recruited there, and in time professional staffing at the national level may be reduced. Concept Note: **Enhancement of Fishery Management Capabilities**

3) The funding of projects providing salaries and a modest budget to create management plans for selected fisheries. These should be long-term (e.g. 5 to 10 years) and should include staffing of a management body to implement a plan for each specified fishery. These projects should pre-specify specific performance measures for the successful management. Salaries could be partially dependent on performance of the fishery, not on sales of licenses. Performance might be based, for example on externally monitored spawning stock biomass, and nearness to targets of fishing fleet size and composition, and catch levels. Taxes on landings, and profits from related fishing industries, could be used later to fund the system. These should be a well defined fisheries such as shrimp (Cilacap, Arafura Sea), Bali Straits sardine, Java Sea purse seine.

Concept Note: **Establish Example Fishery Management Plans, Enhancement of Fishery Management Capabilities**

4) Support to implement the code of conduct in a meaningful way so that Indonesian fisheries can be managed in accordance with this code. **Establish Example Fishery Management Plans.**

5) Implementation of ecosystem based approaches and the development of methods of evaluating these. Efforts can start with the 1) gradual switchover to less damaging fishing gear, 2) the development and use of more selective fishing gear, and 3) the development of ecosystem criteria for management of key fisheries. Ecosystem based management should be a basis of fishery management planning especially in cases where fishing gear are known to be destructive. Concept Notes: **Support for Innovative Approaches for Ecosystem-Based Management**, **Establish Example Fishery Management Plans**.

6) Establishment of marine reserves for fishery purposes. Creation of these reserves could start the establishment of "special management areas" where enforcement of more restrictive fishing rules applies. These could ultimately be designated as marine reserves in the future. Marine reserves should be seen as a part of an overall fishery management strategy. A program should be established to identify and prioritize key areas as marine reserves, including seasonally closed areas, and restricted fishing areas, for each fishery management area. Importantly, appropriate methods of enforcement of special rules within reserves must be an important part of this strategy. Concept Notes: **Design, Selection, and Testing of Concepts for Marine Reserves for Fishery Purposes, Establish Example Fishery Management Plans**.

7) Incorporation of the reality of natural fluctuations into fishery management and planning paradigms. Better understanding of fluctuations is needed, including the development of management approaches that can accommodate planning for such fisheries. Because fluctuations can stimulate a fishery decline, there needs to be an emphasis on precautionary approaches toward favorable stock assessment reports. This approach should strive to avoid over capitalization in

fishery related activities. Concept Notes: **Support for Innovative Approaches for Ecosystem-Based Management**

8) Support for the development of sets of criteria and indicators of sustainable fishery management. These can for a basis for measuring success of fishery management, and can be used in conjunctions with fishery management plans. These can also provide a basis for certification programs for selected fisheries Concept Notes: **Development of Criteria and Indicators for Sustainable Fishery Management / Support for Certification of Selected Fisheries**

9) Support for management of certain selected fisheries as targets for certification. This can include the development of criteria and indicators that must be met to achieve sustainable management of these selected fisheries. Concept Notes: **Development of Criteria and Indicators for Sustainable Fishery Management / Support for Certification of Selected Fisheries**.

10) A clarification of the roles of different levels of government, and support for those roles within a new management paradigm. This clarification must include 1)determination of responsibilities for research, 2)assignment of authority and methods for setting total allowable catch for each fishery, and 3)equitable procedures and responsibilities for allocating catches among stakeholders. Concept Notes: **Indonesia-Wide Fishery Policy Framework Enhancement.**

11) A move away from the *structural* command and control view of the past to a new system where each level of government improves the *functional* aspects the services it provides to the country and community. Emphasis should be on the provision of services and the *quality* of those services. From a resource management perspective these services should 1) improve the knowledge of resources, should 2) help develop management approaches for those resources, and should 3) help implement that management. Concept Notes: **Indonesia-Wide Fishery Policy Framework Enhancement**

12) Techniques to develop, and improve, locally based management systems, including traditional ones, and local participation in larger management systems, without creating unnecessary dependence on various levels of government and external funding. The long term goal is to have community based components

truly local, supported, and funded, by the fishery participants including dependent businesses. Concept Notes: **Indonesia-Wide Fishery Policy Framework Enhancement**.

13) A means of making true progress on the issue of co-management of key resources beyond the fixed area approach. Means of defining all stakeholders, and other management participants need to be developed for the Indonesian situation. Full participation of all stakeholders in developing realistic, successful, co-management programs is one of the major challenges, and opportunities, of decentralization. Also of critical importance in the development of means of accurately monitoring the practical social and ecological outcomes of these management approaches, Concept Notes: **Fishery Co-Management Framework Development**

14) The development of a nested management system, incorporated into fishery management planning and law, whereby clear roles of national, provincial, district and local stakeholders is defined. Rights and responsibilities of all stakeholders and resource participants needs to be clarified. Concept Notes: **Fishery Co-Management Framework Development**

15) Enhanced participation in international tuna management organizations in order to ensure Indonesia's full participation in the management and benefits of these fisheries. Concept Notes: **Support for Cooperation with International Fisheries Organizations**

16) Improved approaches for project conception, planning, and execution are needed. Innovative cooperative and transparent approaches should help to ensure that funding is used strictly for project activities, and that projects are focused on the goals of providing better fishery management and more productive fisheries. Such improvements should include the creation of enhanced, external, project monitoring and evaluation processes. Concept Notes: **Support For Fishery Project Development, Planning, And Execution**

APPENDIX 2 – DEVELOPMENT CONCEPT NOTES FOR MARINE AND COASTAL RESOURCES MANAGEMENT

Marine and Fisheries Sector Strategy Study (ADB TA No. 4551-INO) Sub-Sector: Marine and Coastal Resources Management	
Development Concept Note: **Enhancement of Fishery Management Capabilities**	
Objective	To enhance the abilities and knowledge of Indonesian fishery managers through training, education, participation, and the provision of technical and scientific support.
Background	Many new challenges face Indonesian fishery managers: over-fishing, decentralization, the need to merge traditional, ecosystem, and holistic management paradigms, and the very complexity of the fisheries. New tools and information are available to help solve these problems, but most Indonesian fishery workers do not have access to this information. Of critical importance is the need to make information, new analysis techniques and management approaches more readily available to fishery managers. This can be accomplished in several ways. 1) Improve the ability of all fishery agencies to effectively communicate, both among themselves with the world of fisheries management by improving / installing networking and broadband access technologies. Must include provincial and district levels to be effective. 2) Enhance educational, and associated research, programs to include study of ecosystem based management, ecosystem effects of fishing, benefits and costs of marine reserves, and other new techniques for fishery management. Similarly, training programs, workshops, research/management working groups, and meaningful study tours, should investigate and refine these techniques with staff already working in fishery agencies, NGOs etc..
Proposal	Best suited to a long term, externally funded, program with an initial larger sum (first two years) followed by a more modest annual amount. Should seek partnership funding from bilateral donors for study tours, training programs etc. Duration: 5 years.
Estimated cost	US$7,500,000

Marine and Fisheries Sector Strategy Study (ADB TA No. 4551-INO) Sub-Sector: Marine and Coastal Resources Management	
Development Concept Note: **Establish Example Fishery Management Plans**	
Objective	To conceptualize, plan, establish, implement, *and temporarily operate*, example fishery management plans/programs for selected fisheries
Background	The is a lot of talk, and several reports, about fishery management plans in Indonesia, but until now there has been no successful implementation of such plans for any major fishery. With decentralization the implementation of such plans became more difficult. This ambitious project will strive to create fishery management plans for 2 to 3 selected fisheries. It will attempt to implement all aspects of the plan from initial planning to execution and operation for a few years. Ultimately the management of these fisheries should be continued with self funding. Conceptually each plan/implementation would include full funding for independent staff, office, and support. Plans would be implemented as soon as possible based on existing information/research, but research would form a part of the management goals: to learn about the fishery so it can be managed better. Possible (in 2006) target fisheries: 1)shrimp N. Java, 2)shrimp Cilacap, 3)shrimp Eastern Indonesia, 4)Bali sardine, 5)Java Sea small pelagics.
Proposal	A six year or longer, externally funded project
Estimated cost	US$15,000,000

Marine and Fisheries Sector Strategy Study (ADB TA No. 4551-INO) Sub-Sector: Marine and Coastal Resources Management	
Development Concept Note: **Support for Innovative Approaches for Ecosystem-Based Management**	
Objective	**To support development of innovative approaches that will lead to Ecosystem-Based fishery management**
Background	One of the difficulties with current fishery management is that it is often destructive. World-wide, scientists are striving to work out systems that make fishing environmentally friendly. In addition, more productive/sustainable fisheries management requires the incorporation of ecosystem effects (predator prey relations, climatic fluctuations, habitat changes) into the management paradigm. If these effects are not taken into account fisheries are less productive and can collapse. Typically, in the past, Indonesian fishery research has focussed on traditional stock assessment research at the expense of creating a better understanding of the ecology of target organisms and their environment. This can be rectified through the funding of management oriented research into ecosystem management approaches. Because of the expense of carrying out such research, approaches should emphasize cooperative arrangements between existing research agencies, NGOs, universities, and fishermen.
Proposal	Funding for (5 to 10) selected research projects, based on request for proposals, and a competitive selection of the best designed cooperative research approaches. Duration 5 years.
Estimated cost	US$10,000,000

Marine and Fisheries Sector Strategy Study (ADB TA No. 4551-INO) Sub-Sector: Marine and Coastal Resources Management	
Development Concept Note: **Design, Selection, and Testing of Concepts for Marine Reserves for Fishery Purposes**	
Objective	To develop and apply concepts of marine reserves to specific, selected important fisheries, and to test, and refine these concepts
Background	At present all marine reserves in Indonesia have been provided as a means of protecting coral reefs, typically within marine parks. All allow fishing, but fisheries is not their primary concern. Nevertheless, world wide there is a trend toward the wider use of marine protected areas as a fishery management tool. The effectiveness of these fishery marine protected areas (FMPAs) is still being tested, but clear benefits are know in many cases. FMPAs are especially effective in the protect of spawning aggregations, but can also provide a core area where otherwise over-fished populations can be protected. Obviously FMPAs have to be established in conjunction with fishing communities. Thus, in addition to the traditional MPAs, FMPAs should be examined as a possible fishery management tool. The joint application of both research and implementation aspects of marine reserve science is needed. This can only be done in cooperation with the knowledge of fishermen and/or other domain experts. That is, in many cases a knowledge of fish ecology is needed to help select the best target locations.
Proposal	A project to fund the establishment of FMPAs in 2 to 4 selected locations and to monitor the ecological and fishery effects of these FMPAs. This project might attract funding from International NGOs, or from more traditional funding sources.
Estimated cost	US$5,000,000

Marine and Fisheries Sector Strategy Study (ADB TA No. 4551-INO) Sub-Sector: Marine and Coastal Resources Management	
Development Concept Note: **Development of Criteria and Indicators for Sustainable Fishery Management / Support for Certification of Selected Fisheries**	
Objective	To develop and test the criteria and indicators as methods for assessing the success of fishery management, and to support the certification of selected Indonesian fisheries where appropriate
Background	The establishment of specific criteria and indicators for fishery management success are an essential step in determining the success of management. Criteria define measures of success, indicators are the items that are measured to see if the criteria have been met. These C&I will be somewhat different for each fishery. Clear and careful establishment of C&I will make assessment of fishery management success easier, and more transparent. C&I have been used in forestry and are in use in some areas for fisheries. C&I are particularly helpful, and necessary, for certification of fisheries. Certification can help raise the value of products from selected fisheries. Indonesia needs to examine this approach for the management for selected fisheries to enhance management success, and to work toward certification of some fisheries.
Proposal	A short term project to develop and test criteria and indicators for selected fisheries in Indonesia, and to certify some fisheries if deemed appropriate.
Estimated cost	US$3,000,000

Marine and Fisheries Sector Strategy Study (ADB TA No. 4551-INO) Sub-Sector: Marine and Coastal Resources Management	
Development Concept Note: **Indonesia-Wide Fishery Policy Framework Enhancement**	
Objective	To assist the GOI in defining the roles of different levels/agencies of government in marine resource management, and to support the full development of those new roles within a new decentralized management paradigm.
Background	One of the effects of decentralizations has been the creation of significant confusion over the respective fishery roles for national provincial and district governments. Confusion among the various national government ministries and agencies also persists. These sources of confusion remain significant impediments to good resource management. While the GOI will have to clear up this confusion itself, assistance can be provided. The government appears to be in need of comprehensive legal and policy advice assisted by technical advice for the various sub-sectors, and related to the relative role of locally based management and determination of authority for fishery management plans. This advice should include, at a minimum 1)determination of responsibilities for research, 2)assignment of authority and methods for setting total allowable catch for each fishery, and 3)equitable procedures and responsibilities for allocating catches among stakeholders. Advisors, in conjunction with GOI coworkers, should examine existing and pending legislation and should draft new legislation if necessary to formalize, and pass into law, necessary changes so that clear authority and responsibilities for fishery management are legally determined.
Proposal	Provision of legal and policy advisors, sponsorship of regional discussions, and the provision of draft legislation and enabling rules and regulations to permit clear management of Indonesia's fisheries.
Estimated cost	US$2,000,000

Marine and Fisheries Sector Strategy Study (ADB TA No. 4551-INO) Sub-Sector: Marine and Coastal Resources Management	
Development Concept Note: **Fishery Co-Management Framework Development**	
Objective	To develop, and improve, locally based management systems, including traditional ones, and local participation in larger management systems, without creating unnecessary dependence on various levels of government and external funding.
Background	Traditional fishery management and locally based management are fairly common in Indonesia, and the GOI has supported this type of management. However, these approaches have been, or have become, very dependent on government, or other entities, for their operations. In addition, the real implementation of co-management has been hampered by the lingering effects of central control of decision-making. There is a need to enhance realistic fishery management participation by all stakeholders: not just local people, but fish processors and other stakeholders in national and regional as well as local fisheries. There is a need to enhance and fully develop co-management programs, and tools for doing this need to be researched, developed and applied to Indonesian fisheries. This might include the provision of advisors to stakeholder groups, meeting facilitators, provision of simplified technical material about a fishery to stakeholders, and other approaches.
Proposal	A project to provide training and to assist all stakeholders so they can meaningfully participate in management of fisheries. These approaches can be provided in general and can be applied to a particular (test) fishery.
Estimated cost	US$2,000,000

Marine and Fisheries Sector Strategy Study (ADB TA No. 4551-INO) Sub-Sector: Marine and Coastal Resources Management	
Development Concept Note: **Support for Cooperation with International Fisheries Organizations**	
Objective	To support Indonesia's activities with international fishery management organizations
Background	Indonesian fishing boats participate in a number of international fisheries both by fishing for migratory stocks in Indonesian waters and by fishing in International waters. Important international fisheries have international committees that coordinate research and management of these fisheries. Most important of these are the Indian Ocean Tuna Commission and the Committee for the Conservation of Southern Bluefin Tuna. At present Indonesia is not a member of either of these organizations, and thus does not receive full recognition for its efforts at research and management, and does not receive its full value of the existence of these useful organizations. Indonesia needs assistance to become more fully involved in the international management of these, and other, fisheries, and this can be accomplished via a modest annual funding providing membership fees, travel costs, and a small amount for research and statistical collection purposes to further the goals of the organizations. Duration: 5 years
Proposal	Support for meaningful participation in International fishery management groups, including basic statistical / research data and analysis.
Estimated cost	US$2,000,000

Marine and Fisheries Sector Strategy Study (ADB TA No. 4551-INO) Sub-Sector: Marine and Coastal Resources Management	
Development Concept Note: **Support For Fishery Project Development, Planning, and Execution**	
Objective	To enhance fishery project planning and execution
Background	A large number of fishery projects are funded by external donors in Indonesia each year. Proper management and full assessment of the value of these projects is difficult. There appears to be significant overlap between projects, and project outcomes are often disappointing. On the other hand, the project themselves often contain laudable, achievable, goals. Project planning, implementation, as well as auditing and project evaluation need to be improved. An externally funded, and managed, project could help to rectify this situation. A selection of projects could be externally monitored (in cooperation with GOI participants). The approaches used could also form the basis of training programs and could be used to modify existing project implementation and management approaches.
Proposal	An externally funded, and managed, project to examine fishery project management/implementation approaches and to recommend changes for better project implementation.
Estimated cost	US$1,500,000