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FISH WARS: SCIENCE IS SHAPING A NEW PEACE AGENDA

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Fish Wars: Science is Shaping a New Peace Agenda

DR MERYL J. WILLIAMS AND CHOO POH SZE

Since the dawn of human endeavour, conflicts and wars related to the rights over the use of land and water have been important human issues. Although many of us are probably more aware of wars* fought over religious freedom, political ideologies and social issues, conflicts over fishing rights and resources are just as common, if less reported. A new peace agenda is sorely needed and science must help shape this. Indeed, science will increasingly act as the first port of call of those seeking knowledge to promote the agenda.

Conflicts arise within and between groups of fishers, and between fishers and other community groups. For example, when fishing methods shift from small-scale subsistence to highly efficient modern fleets, conflicts arise between the rights of traditional and commercial fishers. At the heart of most conflicts is the tension between the sustainability of fisheries resources and the rights to, and extent of, their exploitation by humans. Rights over fish are usually ill defined to start with and rarely recognised and assigned adequately as the fishery develops. Their definition and allocation is made more difficult by uncertainty over the size and the state of the resource. For example, most Australians will be familiar with the international conflict over the highly-migratory southern bluefin tuna stocks and the hot disputes over the total quota, scientific evidence on the status of the stock of this species, and national shares of the quota.

Aquaculture, as an emerging aquatic resource industry, is also subject to conflicts over its impacts on the environment and on people displaced from land and coasts by its introduction. As

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* The term 'war' is not used in this paper in the strict sense, accepted for quantitative purposes, by Soysa and Gleditsch 1999. Strictly, a 'war' is an armed conflict with over 1000 battle-deaths in a single year.

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resources become scarce, land use conflicts between different stakeholders may become serious issues.

Ironically, wars external to the aquatic resources sectors can protect the fish because they prevent fishing. The fish stocks of the North Sea rebounded dramatically during the course of World Wars I and II because fishing ceased during the wars. Fish can also provide a subsistence food source for the refugees of war as they have done in Sarajevo and Cambodia, because, unlike terrestrial crops that need to be planted and tended, wild fish stocks continue to produce.

When resources dwindle, conflicts arise as to what constitutes wise use of resources, and stakeholders will often disagree on a common solution. Habitat and resource degradation often become important issues at about this time. The use of destructive gears, fishing over sensitive habitats and over-fishing often give rise to conflicts between different interest groups. For example, negative effects (which include direct mortality, reduction in diversity, biomass and of individual organism size) of the trawl gear on the bottom-dwelling organisms in both sandy and muddy grounds have been highlighted by some researchers (Bergman and Van Santbrink 2000; Ball et al. 2000). Such impacts have alerted environmental action groups and scientists to question fishing activities. The cessation of most whaling is partly a result of confrontation between the whaling industry and public interest groups.

Fish is a very important food source, especially in the developing countries. Unfortunately, despite being so, it is often excluded from projections of future food supply. Aquatic resources make up 19% of total animal protein consumed and 4% of total protein consumed (FAO 1992a). The International Center for Living Aquatic Resources Management (ICLARM) (1992) estimated that about 50 million people are involved in small-scale fisheries through catching, processing and marketing, and fish production provides about 150 million people with employment.

Food security may be threatened when stocks are fished close to the level of collapse, coupled with problems of habitat degradation and destruction that may have negative effects on fish recruitment. Pauly and Christensen (1995) estimated that 8% of the world's aquatic primary production is required to sustain the fisheries compared to 35% to 40% required to sustain terrestrial systems. Scientists from the University of British Columbia, Canada and ICLARM have shown that humans are 'fishing down the food web' and the present exploitation patterns are unsustainable. Coral reef habitats rank amongst the most threatened aquatic habitats. ICLARM scientists working with others showed

that 58% of the world's reefs are potentially threatened by anthropogenic activities, with 80% of the coral reefs in the South-East Asian regions at highest risk (Bryant et al.1998).

The issues pertaining to the protection and conservation of the environment and resources were given wide coverage in the Rio Conference held in 1992. As we approach Rio+10 in 2002, we are facing even more serious conflicts and a poorer resource outlook for many fisheries. The outlooks, however, present real glimmers of hope promised by some recent insights from international scientific research.

This presentation attempts to highlight some of the conflicts arising from fish and fishers and their impacts especially on the poorer nations. It discusses how some of these problems can be overcome by innovative research partnerships, and the roles of fisheries research in shaping the new peace agenda necessary for assuring food security.

Conflicts and Solutions through Innovative Research Partnerships

Conflicts over the right to fish and to the fisheries resources are endemic in fishing industries all over the world, with some of these conflicts developing into open wars. In South-East Asian waters, fights between inshore (traditional small-scale) and offshore (larger commercialised) fishers are common. Trawling vessels encroach onto traditional fishing grounds and habitats such as mangroves and corals because these are the most productive areas. Negotiations by the Abu Sayyaf gunmen in the Jolo hostage crisis include demands for the return of fishing rights over their inshore waters, referred to as the 'municipal waters' under Philippine law. Within countries, fisheries conflicts often are compounded by ethnic differences between the fishers and the rest of the community and/or by migrations driven by many different positive and negative factors. Internationally, illegal fishing by foreign vessels in another country's territorial waters also causes strained relationships between countries (Dupont, these proceedings).

Fish wars also wage amongst the industrialised countries. Cod wars were fought between the United Kingdom and Iceland in the 1970s. In the 1990s many conflicts amongst fishing fleets within the European Union were reported. British and French vessels fishing for tuna were attacked by the Spanish, and French fishers rioted over minimum European Union fish prices. The situation was no better in the high seas where countries fought for straddling and highly migratory fish stocks; countries such as Australia, New Zealand and Japan still do over southern bluefin tuna.

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In 1982, the United Nations Convention on the Law of the Sea (UNCLOS) paved the way for nations to claim rights to the fisheries resources within 200 nautical miles of their coasts. This dramatically changed the map of responsibilities for fisheries and also spurred a major fisheries expansion as nations tried to capture the benefits of these resources by developing their own fleets. UNCLOS also established fishery management power in the hands of national governments, often inadvertently taking control away from the users and stakeholders. The latter are often deemed to be too ignorant and inexperienced to undertake the complexities of fisheries management, even though traditional and local management was often the only previous means of control over exploitation of the stock.

In the post-UNCLOS period, countries have attempted to build management decisions around technical rules and regulations derived from models such as the sustainable yield models. These may not always reflect the dynamics or the complexities of the fisheries resources in their biological systems (McGlade 1995). Estimating the abundance of fish stock is not easy and to sustain the resource is also a difficult task, especially when immediate social and economic pressures push for exploiting not just the surplus but also the resource base (Williams 1996). In tropical waters the complex situation with high biodiversity makes the estimation of sustainable yields even more difficult.

Despite millions of dollars spent on monitoring and enforcement, fisheries resources are known to have collapsed in countries from all over the world. An FAO study (FAO 1992b) showed that out of 200 fished stocks in all parts of the world, more than 25% were over-exploited, depleted, or recovering and would produce greater catches only if returned to a healthier state. Thirty-eight per cent were fully exploited and could not produce more catch without depleting the base stock. Only a little more than 33% could produce more.

Many hypotheses have been proposed to explain the failures of fisheries management. These range from 'folly' to deficiencies in data and information and poor management institutions (Smith 1998). In many developing countries, the national fisheries departments do not have the capacity to conduct regular fisheries assessments, management and regulatory activities. Worse, governments usually exacerbate the problem through encouraging more intense fishing through subsidies and financial assistance to the commercial fishers.

Finding better ways to manage fisheries has become an imperative. In recent years, fisheries departments have focused more on their institutional options, and many national governments are

attempting to devolve management powers and implement co-management (power sharing between governments and stakeholders) or community-based management (self-involvement in management) to regulate fisheries resources. In a review of management of the fishing lots or concessions for inland fisheries of Cambodia, it was pointed out that any new management system must be developed in full cognisance of the pre-existing and historical institutions for the sector. Indeed, co-management systems are being found to work for the management of lagoon, near-shore marine resources and inland fisheries. Successful co-management models include the co-management of the inshore fisheries in Japan. There are many examples of effective community-based management systems, like those found in the Pacific Islands and several in the Philippines (Katon et al. 1997).

Where applicable, co-management and community-based management potentially are effective in managing resources because they take into consideration the needs of the stakeholders, and utilise their environmental and fisheries knowledge.

Hardin (1968) called the tendency to over-exploit fisheries and other common resources the 'tragedy of the commons'. However, recent thinking is that over-exploitation occurs not because of the ownership (common property or individual) but because access is open to all and unmanaged (Hardin 1998). In such a situation there is no interest in limiting fishing and everyone lands as many fish as possible, as not doing so will enable others to catch more. Thus fishers compete intensely with each other, leading to conflicts, over-exploitation and stock collapse. Some traditional systems show that access to commons resources can in fact be regulated. In the Solomon Islands, common property-type systems of marine tenure have been successfully practised for fisheries management of some reefs and lagoons (Hviding and Baines 1992). Fishers themselves manage the access and fishing of the resources according to traditional and customary laws. These systems provide for stock rotation, periodic reef closures, community involvement, group control, stock monitoring, ecological knowledge and understanding. In Ontong Java, in the Solomon Islands, although no government regulations exist for the management of sea cucumbers, the community itself took on the task of managing the fisheries by restricting harvesting to every other year (Richards et. al. 1994). How well these systems will survive the ravages of the present Solomon Islands inter-ethnic wars remains to be seen.

Seeking better solutions for fisheries management in developing countries, ICLARM has been engaged in research on co-management and community-based fisheries management regimes since 1990. In keeping with the overall mission of the

...there is no interest in limiting fishing and everyone lands as many fish as possible, as not doing so will enable others to catch more.

Center, our target beneficiaries are poor men, women and children. Following an early start in Bangladesh, in 1994 we commenced a long-term collaborative project with researchers, community groups and fisheries managers in the Philippines, Vietnam, Thailand, Malaysia, Indonesia and Bangladesh in Asia; and Malawi, Zambia, Zimbabwe, Mozambique, South Africa, Benin, Cote d'Ivoire and Senegal in Africa; and the Institute for Fisheries Management (IFM), Denmark. The objectives of the project are:

- to gain practical experience in research in fisheries co-management;
- to demonstrate under what conditions it may be applicable as a sustainable, equitable and efficient management strategy; and
- to develop models for use and adoption by governments, fisheries communities, NGOs and others.

In its first phase, the project analysed 14 case studies from Asia, carried out in a variety of fisheries situations (Kuperan 1999). In all cases, the access and withdrawal rights were held by the fishers but management rights rested with communities and the state. Outcomes were measured in terms of equity, efficiency and sustainability, although not all indicators were measured in every case. Nine out of 10 case studies indicated improvements in the equity situation; 11 out of 14 showed improvements in efficiency outcomes; and, most promisingly for the sustainability of the resource and livelihoods, 9 out of 14 cases showed improvements in the resource situation.

Mixed results were obtained from 8 case studies undertaken in Africa (Kuperan 1999). In 3 cases, fisher representation in decision-making increased; in 4 cases, the ability to resolve conflicts improved; 4 out of 8 cases indicated improvements in control of destructive fishing and enforcement of regulations; and in only 2 out of the 8 cases did the village committees enjoy strong community support.

The fisheries co-management project of ICLARM is linked to the Consultative Group on International Agricultural Research (CGIAR) System-wide Initiative on Property Rights and Common Property Resources, covering fisheries, forests, rangelands, water and other commons resources. Some lessons, but by no means all, are transferred across different resource types.

In 1998 a three-year project entitled 'Sustainable management of coastal fish stocks in Asia', was initiated by ICLARM, together with eight developing member countries of the Asian Development Bank, namely Bangladesh, India, Indonesia, Malaysia, Philippines, Thailand, Sri Lanka and Vietnam. The main aim of

the project is to provide the countries with updated tools and help their institutions develop strategies to improve the management and sustainable utilisation of their coastal fisheries and related ecological systems. The project objectives are:

- to develop a fisheries resource information system that relates environmental and socioeconomic factors to the resource management needs of the selected countries;
- to develop appropriate strategies and action plans to assist the selected countries in managing their coastal fish stocks based on analyses of the completed information; and
- to strengthen the capabilities of institutions in these countries in the assessment and management of coastal fisheries.

Early results of the project are confirming, often from little utilised but existing data, that the overall status of the resources is dismal, and bottom-trawling practices especially should be reduced. The economic and biological wastage is large. The policy dilemma for governments is that, despite their equity and distributional goals, sectoral assistance is misplaced and goes primarily to the large-scale fishers. The project is helping government fisheries managers to recognise and develop prescriptions to tackle the problem.

These two fisheries management research projects, which involve working closely with many partners, show both the challenges of fisheries resource management and offer insights into possible solutions. The peace agenda clearly includes evolving human institutions that recognise the stakeholders and involve them in suitable ways, and use data to develop new knowledge.

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Aquaculture

Aquaculture first originated in China in 1100 BC. The first cultured fish is believed to be the common carp; later on during the Tang Dynasty (618—904 AD) polyculture and integrated freshwater fish farming systems were also developed. The Chinese and Indian carp constitute the greatest share of world aquaculture production today and accounted for 45.6% of the world's production in 1995 (Rana 1997). Carp are the most popular species of fish cultured in the world. They are amenable to polyculture, i.e. the culture of several different species in one water body, and integrated farming, i.e. the farming of fish and other agricultural crops through recycling of on-farm nutrients and organic wastes. Carp are either herbivores or omnivores, with feeding habits that are met with diets that are low in protein, and are therefore good candidates for sustainable practices.

Despite its apparent antiquity, aquaculture has only burgeoned

...feeding fish (as fishmeal) to grow fish actually reduced the total amount of fish available to humans.

...the great economic benefits that low-income people could derive from aquaculture with appropriate development assistance interventions.

since the 1970s when rapid development of semi-intensive and intensive cultures occurred. The sustainability of the new developments has been hotly debated ever since. Conscious of the debate and drawing on its wide experience in aquaculture in freshwater and marine environments in developing countries, ICLARM has recently released a statement of its position, called 'Farming fish the right way' (ICLARM 2000).

Most of the controversies have centred on carnivorous species cultured in brackish or marine environments, especially penaeid prawn and salmon (Naylor et al. 1998). Naylor et al. (2000) calculated that feeding fish (as fishmeal) to grow fish actually reduced the total amount of fish available to humans. Conflicts arising from modern aquaculture mainly involve environmental issues, although some culture activities cause social problems. Adverse effects include habitat destruction, discharge of effluents containing high concentrations of organic matter and the tainting of the aquatic environment and organisms with chemicals. Common-user conflict, the introduction of exotics that may alter the diversity of the natural flora and fauna, and the escape of feral organisms from culture systems, are some of the associated issues. The siting of ponds can cause conflict among the various interest groups.

In Indonesia and the Philippines, conflicts arose between the padi and fish farmers when productive rice fields were converted to fish ponds (Beveridge and Phillips 1993). In Malaysia, problems were encountered when padi farmers were directed to sell their land for conversion to shrimp farms. Rosenthal (1994) is of the opinion that aquaculture offers more benefits than negative effects and attributes the intense hostility against aquaculture, especially in industrialised nations, to lack of public involvement and understanding. Williams et al. (2000) noted the great economic benefits that low-income people could derive from aquaculture with appropriate development assistance interventions. Part of the basic public unease with modern aquaculture could be its novelty, that it is something new and man-made (ICLARM 2000).

In the tropics, the most controversial farmed species, the penaeid shrimps or prawns, have received worldwide attention. Environmentalists object to the use of mangrove land for farming, and self-pollution from farms crowding close to each other have caused disease problems and mass mortality. The conversion of mangrove land to shrimp farms has also transformed a common-user resource to a single-user resource. Social problems arise when coastal fishers are denied access to the mangroves and complain of the loss of earnings from reduced catches.

ICLARM's work in sustainable aquaculture is focused largely on the interdependence of people, aquaculture and the environment. ICLARM subscribes to the belief that increasing the access of the rural poor to productive resources is the key to sustained increases in food security (Ahmed et al. 1997). Poverty may deprive the poor of food, and hunger spawns conflict. Food and economic insecurity, and scarcity of natural resources are often major sources of conflict (Messer et al. 1998).

Although some semi-intensive and intensive culture of carnivorous species has damaged the environment and created social problems, overall, aquaculture can and is being carried out sustainably with a consequent increase in food production. Since the world's landings from capture fisheries have already reached their limits of about 89 million metric tonnes, the main growth sector in fisheries production is through aquaculture. It is therefore essential that aquaculture policies in all countries be appropriately planned and implemented without compromising the health of the aquatic environment. This may involve resolving conflicts among competing stakeholders, which may include those on the land who release effluents into aquatic systems.

How can aquatic research be used to help avoid conflicts in aquaculture development? An important starting point is the choice of species for culture, since this governs feeding, culture systems, inputs and markets. ICLARM works mainly with native species or species that have already been introduced, to avoid the negative effects associated with the additional introduction of exotics. Tilapia, although an anathema to most Australians, is a species of choice. Although it is a native to Africa, it has been farmed extensively in Asia and Africa and is increasingly important in the Americas. ICLARM's work on selective breeding for the genetic enhancement of the Nile tilapia for aquaculture in Asia has produced a strain (GIFT) that has a significantly higher growth than the strains already cultured, and can be produced at a lower cost, thus bringing it within the reach of more people.

ICLARM's research in the Pacific Islands on the culture of high value species, namely sea cucumbers, giant clams and the blacklip pearl oyster, is also highly environmentally friendly and requires surprisingly few inputs. The Australian Centre for International Agricultural Research (ACIAR) is the key supporter of this research. The species cultured are benign both in their demand for food and their effects on water quality. The sea cucumbers are detritus feeders, the giant clams obtain their food from a symbiotic relationship with microalgae, and the pearl oysters are filter feeders. Since no extraneous feeding is required, these organisms actually cleanse the environment. The culture of

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Another critical way that aquaculture development can help reduce conflict is by helping reduce inequalities. For this to occur, aquaculture must be accessible to the poor.

One technology suitable for many rural poor is integrated aquaculture-agriculture (IAA), involving the culture of fish in small water bodies.

these organisms not only provides food and income to the islanders, but the hatchery-produced seeds are also used for restocking programs.

Before it was closed due to the current Solomon Islands civil war, the ICLARM Coastal Aquaculture Centre (CAC) in the Solomon Islands had successfully developed breeding and farming methods for five species of giant clams. Seeds were produced in the hatchery, raised on small-scale marine farms run by the local village people and sold to the aquarium trade. Restocking of natural habitats to replenish natural stocks has been linked to their farming operations, and restocking programs are being attempted in 16 countries. Educating farmers on the need to protect the dwindling resource is encouraging them to control the harvesting pressure. In the Solomon Islands, 30 village farmers retain 2% of the marketable clams for restocking reefs under their tenure. However, the present Solomon Islands unrest has halted a suite of downstream development projects that followed on from the research. ICLARM is also engaged in developing simple low-cost scientific methods for producing sea cucumber larvae en masse and raising them to a stage where they can be released and survive in the wild to restore depleted stocks.

Another critical way that aquaculture development can help reduce conflict is by helping reduce inequalities. For this to occur, aquaculture must be accessible to the poor. Deliberate and planned interventions are needed to involve low-income people in aquaculture production and/or, through improving the efficiency of aquaculture production, make fish more affordable for them.

One technology suitable for many rural poor is integrated aquaculture-agriculture (IAA), involving the culture of fish in small water bodies. The objective of the IAA system is to optimise farm production and the use of the biological outputs from the farm through recycling, and integration of aquaculture into the system. ICLARM's work on IAA is focused on small farms and its target beneficiaries are small and subsistence farmers and other rural people, especially women, who do not have the knowledge or financial resources, or often even the land, for intensive, high-value, or commercial activities. Research on IAA systems has been carried out in Ghana and the Philippines, and continues in Bangladesh, Malawi and Cameroon.

Scientists, farmers, NGOs and government agencies have had to work closely together to understand and improve the technology and its adoption. Each country and site presents a set of different ecological, biological and sociological conditions, highlighting the need for developing site-specific systems.

For example, in Bangladesh, ICLARM has tapped into the

very effective NGOs to be research, dissemination and extension partners and reach the poorer people, especially women, that normal government extension services were missing (Gupta et al. 1999). The research focuses on maximising fish production from unused or under-used ponds with methods that are feasible, affordable and acceptable to resource-poor households in rural areas. The average production increased by 452%, and net cash benefits and household nutrition improved through the higher consumption of fish. Women constitute a significant proportion of the beneficiaries and were the most valuable participants.

In Ghana, Malawi and the Philippines, the work is more on an experimental basis involving a small number of farms over different ecological conditions. In Ghana research was focused on introducing aquaculture in ponds surrounded by vegetable gardens. Results showed that, following one fish growing cycle, net income improved by 180%, biomass output by 10%, the number of species used by 13% and the types of recycling by 220%. Farm households also increased their intake of protein from the fish and of vegetables. Experiments in Malawi showed that participating farms had a 50–80% higher production of fish than the best farms with ponds that were not integrated. IAA farms had greater food availability, better rice crops and a better supply of water for the farm, garden and household. In the Philippines, participating farms experienced an increase in income from US\$350 to US\$750, total biomass output from 7 to 8 t/ha, the number of species cultured from 6 to 11 (ICLARM 2000). This resulted in significant increases in income, production, food availability and sustainability of the farms.

Thus, research can help the aquatic sector resolve its conflicts through such means as advising on species selection, developing new environmentally-friendly and low input species, improving access to the technology and increasing the profitability of recycling systems for small and landless farmers. The peace agenda for aquaculture is heavily dependent on science for its directions.

The Contribution of Fisheries Research to the Peace Agenda for Food Security

Some of the previous examples of scientists and others working together show how science is reducing the conflict in the fisheries and aquaculture sectors. This is good news for many scientists who have been soul searching over their role in fisheries management, and generally seeking to clarify their part in the peace process.

The 'fish wars' have generated many papers on the failures of fisheries management and the need for fisheries science to

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But the present trend in fisheries development in many parts of the world shows that current research is insufficient to cope with the present day problems, let alone to meet future challenges.

consider itself within the full management context (de la Mare 1998). This involves considering the whole system of fisheries and their management institutions, not just its parts, such as the resource, monitoring and surveillance and fleet and market economics. Management objectives and procedures have traditionally been viewed as outside the purview of fisheries science. Smith (1998) recommended that fisheries science extend to cover the scientific study of management, warning that a lack of focus on the whole of fisheries would leave fisheries science ineffective in the future as in the past.

Until the last decade, aquatic resource management research had mainly focused on resource biology, stock assessment, gear development, aquaculture research and a small amount of economic and social research. These inputs were probably sufficient when resources were under-exploited, aquaculture small and of the non-intensive scale, and human populations lower. But the present trend in fisheries development in many parts of the world shows that current research is insufficient to cope with the present day problems, let alone to meet future challenges.

Williams (1996) reviewed the contribution fisheries research could make to food security. Since the resolution of major conflicts is a prerequisite for food security, these contributions are relevant to the peace process. Research now needs to be broad in its disciplinary base and must play a range of roles.

Firstly, research can provide basic information on which strategic and applied studies can draw. Basic research includes studies like fish taxonomy, fundamental knowledge on biodiversity, economic market theory, trophic dynamics of ponds and ethnographic studies. The main users of the results from such studies would be other researchers and the general public. Scientists are expected to provide ready access to the results of this fundamental research through the traditional scientific literature and through modern information technology such as the Internet.

Secondly, research can identify critical issues and their implications. These issues may become the source of conflicts, and science may find itself as the messenger bearing bad news. Scientific studies may assess the status of an exploited stock; social science studies may reveal problems in how the catch is shared; and marine biology studies may reveal an unwelcome shift in species composition, e.g. to lower value species. The findings from such studies could be made use of by policymakers, fisheries managers, fishers, fish farmers and other researchers. These results must be conveyed in a way that clearly explains their meaning and consequences and the researchers must be aware of the context within which they communicate their results.

Thirdly, research results can be used to resolve conflict. Studies can be planned to address management questions such as:

- What will be the benefits for the fisheries resource, the local economy and for the fishing communities if a protected area is established?
- How big should this protected area be and where should it be sited?
- Should this fishery be managed as a single stock or as separate substock?
- What is the risk of stock collapse if catches are increased?
- Which groups or parts of the community will benefit or be disadvantaged by the new management regulation?

Users of the research will be those involved with the conflict or their representatives in committees and negotiating parties. There are many excellent cases in developing countries where local universities and action-research based NGOs are closely involved with community groups and local government actors in the management of coastal and inland aquatic resources. This is a relatively recent phenomenon, dating only from the 1990s in most countries.

Fourthly, research may be able to produce innovations, new solutions and options. For example, present day aquaculture research utilises new technology, like using genetic engineering and biotechnology as tools to select new species strains, new feeds and the production of vaccines for disease control. Fisheries production may become more efficient with the introduction of new gear, improved vessels and post-harvest technology. This role is usually used when no immediate conflict exists, or after a conflict when the parties have entered a phase of seeking other options to the problem. The users of this type of research are usually fishers, farmers, fisheries managers and other policy-makers.

All these four roles are critical components, directly and indirectly, of establishing the way forward for the aquatic resources sectors. If all are used, scientific research should have a major role in shaping the agenda for peace and sustaining fisheries and aquaculture development.

Conclusion

Fisheries and aquaculture often operate in an environment of strife, buffeted by internal conflicts and deeply affected by external events (Williams and Perez-Corral 1999), including wars and armed conflicts other than 'fish wars'. A stable political environment is a primary requirement for the development of people and the eradication of poverty. The same is also true for the

International aquatic resources research has a leading role in shaping the peace agenda for fish.

development of a sector. Knowledge gained through well-targeted and delivered research involving, or at least recognising, the views and aims of stakeholders, is essential in moulding the peace process and developing the sector. International aquatic resources research has a leading role in shaping the peace agenda for fish.

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