# THE COMMON PROPERTY RESOURCE PROBLEM:

# SUSTAINABLE DEVELOPMENT AND THE FISHERIES

# OF BARBADOS AND JAMAICA

Fikret Berkes

Institute of Urban and

Environmental Studies

Brock University

St. Catharines, Ontario

Canada L2S 3A1

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## Introduction

The term "common property resources" refers to those resources which are owned collectively by members of some group. Where such resources are freely open to any user (open-access) and subject to intense use, often the end result is depletion and degredation. One of the obstacles to the implementation of any kind of stewardship principle, such as the World Conservation Strategy (1980), is this common property resource problem (henceforth the commons problem). Water, forests, grazing lands, wildlife and fisheries -- many of the resources for sustainable development -- are basically common property resources. How is sustainable development, that is, development that can be maintained over the long-term through the protection and conservation of living resources, possible when many of these resources are subject to the a all~pervasive commons problem?

The problem is a complex one, and there is some urgency to examine alternative approaches towards it solution (Ruddle and Johannes, 1985; Regier end Grima, 1985; Berkes, 1985; McCay and Acheson, in press; National Academy of Sciences, in press). The classical approach to the problem is the replacement of open-access common property arrangements with private property rights, as in the privatization of English grazing lands. This solution may be possible for the more readily appropriated resources; but for many marine resources for example, including fish, this is just not possible.

Nevertheless, Eckert ( 1979) , among others, has argued that the emerging international ocean management regime may best be considered an "enclosure movement", an attempt to establish property rights over marine resources. This may be accomplished through such mechanisms as the allocation of exclusive and transferable rights to individuals, firms or other entities. The logical conclusion of this line of reasoning is the allocated catch quota system in fisheries (Clark, 1981; Clark, 1985).

But is privatization the only solution to the commons problem? Some authors have argued that the current Western notion of "common property" and solutions based on the assumption that such resources are unowned (res nullius) may be inappropriate for non-Western countries. In the case of fisheries, some also question if such solutions are necessarily appropriate in the Western World (Lamson and Hanson, 1984; Berkes, 1985). Ruddle (1985) suggested that the "essentially village-based control provided by the Japanese system of small-scale fisheries organization" is an alternative management model, but one in which the historical roots of the system *are* all important. At a major conference on common property resources of the Third World, it was shown that a rich diversity of common property institutions exist for local-level management not only in fisheries but also in water, forest, grazing land, wildlife and communal agricultural land resources (National Academy of Sciences, in press).

The primary aim of this paper is to examine alternative approaches to solving the commons problem as relevant to sustainable development. First, an attempt has to be made to address the confusion created by differences in the definition of "common property resources". Second, the different formulations of the commons problem need to be analysed.. This will be followed by a case study of Caribbean fisheries to explore the dimensions of an inshore commons problem (Jamaica), and an international commons problem (Barbados), and their possible solutions. Finally, some emerging principles of common property resource management will be offered towards a practical framework for sustainable development.

## The Question of Ownership of Common Property Resources

There is controversy over the use of the term "common property resources". They are resources used or held in common, but in common by whom? According to one definition of the term, these resources are basically open-access and freely available to any user within that country (Christy, 1982). In many countries, fisheries are actually defined in law as being open-access common property.

According to a second definition, the term "common property" should be restricted to those resources for which there exist communal arrangements for exclusion of non-owners and for allocation among co-owners. "Economists are not free to use the concept of 'common property resources' or 'commons' under conditions where no institutional arrangements exist. Common property is not 'everybody's property'. The concept implies that potential resource users who are not members of a group of co-equal owners are excluded. The concept of 'property' has no meaning without this feature" (Ciriacy-Wantrup and Bishop, 1975).

Bromley (in press) suggested the use of the term "common resource" to refer to a resource that is used by more than one individual, family or Kinship group (depending upon the cultural context}, and the restriction of the term "common property resource" to situations where common property arrangements exist. The concept of common property in this sense is well established in formal institutions such as the Anglo-Saxon common law and the Roman Law (Ciriacy-Wantrup and Bishop, 1975). It is also **well** established in informal institutional arrangements based on custom and tradition. There is a particularly rich documentation of this from Oceania and Asia (Ruddle and Johannes, 198B; Ruddle and Akimichi, 1984). How, then, have we come to associate common property with open-access or a free-for-all?

Bromley (1985) suggests that our thinking is shaped by the market-oriented economics of the Western Industrial Society. Having abandoned a rich tradition of common property and communal ownership, we tend to think of property arrangements over natural resources to be at two extremes: there is either private property or a free-for-all. Since a free-for-all will almost certainly result in the degredation of the resource, it is then concluded that the solution is to create private property over scarce and valuable resources. The analysis is self-fulfilling: "Small wonder that our paradigm starts with the assumption that all valuable resources *are* individually owned, fully mobile, and exchangeable in small increments in well functioning markets. We then conclude that these conditions will assure an efficiently operating system" (Bromley, 1985).

A rel-ited problem is the assumption that the individual self-interest is supreme, even though the Western concept of individualism is an anomaly in historical and cultural context. According to Ophuls (1977, p. 226): "...we have been living in an age of rampant individualism that arose historically from circumstances of abnormal abundance. It seems predictable, therefore, that on our way toward the steady state we shall move from individualism toward communalism...the traditional primacy of the community over the individual that has characterized virtually every other period of history will be restored."

Given our existing cultural and economic "blinkers", the confusion over the term "common property" is likely to persist. Perhaps one solution is to make at least a clear distinction between open-access common property which in practice means unowned (res nullius), as opposed to controlled access common property with communal arrangements [res communes}.

Formulations of The Common Property Resource Problem

There have been at least three different formulations of the commons problem. Each of these incorporates different assumptions, emphasizes different aspects of the problem, end provides clues towards alternative solutions. Perhaps the most famous of these formulations is Hardin's (1958) "tragedy of the commons", The parable refers to the overgrazing of pasture lands owned in common. Each herdsman seeking gain naturally desires to increase the size of his herd. But the commons is finite, and sooner or later the total number of cattle will exceed the carrying capacity of the land. Yet, even when this happens, it is still in the rational self-interest of each herdsman to keep adding animals to his herd. His personal gain from adding one more animal outweighs his personal loss from the damage done to the commons -- because the damage is shared by all. But since all herdsmen use the same logic, eventually they all lose. Hence, the competitive overexploitation of the commons is the inevitable result, a "tragedy" in the sense of ancient Greek tragedies according to Hardin, in which the characters know that the disaster is coming but they are locked into it and are unable to do anything about it.

A second formulation of the problem comes from economics (e.g. Pearson 1975). It starts with the observation that resources such as clean air or clean water do not generally command market prices. Without prices there is no incentive for optimal allocation or for conservation. With increasing demands over time, however, these resources become economically scarce. This, in turn, may be expected to result in the emergence of property rights and of markets for the exchange of these rights.

In the case of ocean resources, "the process of conversion to more exclusive ocean resource rights...is a first step for removing the efficiencies that result from communal rights" (Eckert, 1979, p. 16). However, there are technical difficulties in creating private property arrangements over resources such as air, water and ocean fish. In such cases, it may be best to identify the costs created by the various uses of the resource, costs which are external to that use but which are borne by others ("externalities" or "external diseconomies"). It then becomes possible, at least in theory, to develop mechanisms to "internalize" these costs, that is, to have the market prices of goods and services reflect the full costs of production, including the cost of damage to others.

A third formulation of the problem uses the game-theoretical framework and the "Prisoner's Dilemma" game (Clark, 1981]. Consider the strategy matrix for two competing resource users, A and B. Each user, for the sake of simplicity, has just two strategies available: "conserve" (C) or "deplete" (D). If both users employ the conservation strategy, let us assume that they share a sustainable yield of six arbitrary units. If, however, one of the users employs a depletion strategy while the other one conserves, then the first user will receive four units and the second user one unit. Total benefits have declined to five units as a result of depletion. Finally, if both A and B employ the depletion strategy, each receives two units; the sustainable yield has declined further to only four units. Which strategy are the users likely to adopt?

The "solution" to the non-cooperative exploitation game is for both users to deplete the resource — because if one conserves, the other one has an incentive to "defect". From the individual point of view of each user, the safe strategy for each is to deplete the resource, i.e., there is a single pure strategy equilibrium at DD (Rapoport, 1985), But this way, both players wind up losers; hence the "dilemma". The real solution, of course, is a cooperative solution: if both users can agree to conserve the resource, they can thereby maximize the total sustainable benefit. Interestingly, the Prisoner's

Dilemma game does have equilibria that lead to the outcome CU (Rapoport, 1985), and the conditions that lead to this cooperative. solution have been explored both mathematically and experimentally (Axelrod, 1984).

The "tragedy of the commons" analysis of the commons problem is the most pessimistic of the three. In casting the problem in the form of a Greek tragedy, Hardin creates a powerful deterministic model in which no solution is possible within the premises of the parable (Stillman, 1975). One of these premises is that the users are unable to get together to solve their shared problem. The model assumes open-access common property resources and the supremacy of individual self-interest over community interests. These assumptions simply do not hold over a wide variety of case studies (Berkes, 1985).

In the analysis of the commons problem as "externalities", the emphasis is on the privatization of the resource, where this is possible. The costs shared by Hardin's herdsmen are externalities for which market solutions are sought to induce the inclusion of these costs in the cost of production. This way, each herdsman would no longer have a rational self-interest to add to his herd. Since he could no longer pass the cost on to others, he would personally have to bear the full cost of adding one more animal to the overgrazed commons. The solution assumes that inefficiencies result from communal rights, and contains the circular argument pointed out by Bromley (1985) that "our system" of private property must be the desirable outcome.

The "Prisoner's Dilemma" analysis emphasizes the "nonzero sum" nature of the game, and the conditions for cooperative solutions. The sum of the benefits from the resource for A and B (and up to n users) is not a constant but depends on the exploitation strategies used. While the non-cooperative solution (DD) resembles Hardin's "tragedy", the game also has a cooperative solution (CC) in which the users may enter into agreements to their mutual benefit. While the economic analysis focuses on externalities, the "Prisoner's Dilemma" analysis is not dependent on market solutions but rather on direct communication and cooperation. Axelrod (1984) has shown that one important condition for the evolution of cooperation is the repetition of encounters between individuals. Once cooperation based on reciprocity starts, it can develop and persist, displacing uncooperative strategies. With these specific features, the "Prisoner's Dilemma" analysis may be the most realistic of the three as a paradigm to analyse the commons problem.

## Fisheries of Barbados and Jamaica

There are a number of similarities and a number of differences between the fisheries of Jamaica and Barbados. Both operate in waters that are relatively poor biologically (Hess, 1961; Munro, 1983). Both countries are net importers of fish products, and both have policies of self-sufficiency. Both have promoted fisheries development since the 1950s by encouraging mechanization and the building of more and larger-fishing vessels. Yet yields have increased little, if at all, since HESS' (1961) review in which the typical annual landings were given as 4,100 tons (metric) for Barbados *and* 7,300 tons For Jamaica. The official FAO statistics, from the earliest years available, are shown in Figure 1. Sahney (1982) contends that the catches have not changed much from 1960 to 1980. Thus, the "bulge" in the 1960-70 period may have been an artefact of the yield estimation procedure, and note real fluctuation.

The major differences are in the type of fishing fleets and the marine environment exploited by them. Jamaica has a large shelf area of 3,420 sq. km and some 10,000 licensed full-time and part-time fishermen (National Atlas of Jamaica, 1971). Almost all of Jamaican fishing takes place on the shelf area, from 2020 outboard-equipped and 1740 non-mechanized canoes, according to 1981 data (Sahney, 1982). Some of these are dugout canoes, and some are open boats built in the style of dugouts. A few of the larger mechanized boats *are* engaged in trolling for large pelagic species such as tunas, hut there really is no offshore fleet that specializes on open ocean fish. Most fishermen use fish "pots" and specialize on reef fish. Many do handlining for species such as red snappers. There is a growing gillnet fishery For small inshore pelagic species (Harvey, 1982).

By contrast, Barbados has a major offshore fleet of some 500 inboard-powered vessels of mostly 10-12 m length. There are some 2,000 full-time and 1,000 part-time licensed fishermen. A large majority of these take part in the offshore fishery, engaging in the inshore fishery using traps and handlines only in the off-season (the fall months) when the migratory pelagic species are not available (Mahon et al., 1982). The trap fishery is small and depressed, partly due to the small size of the reef and shelf areas around Barbados (340 sq. Km.), and partly because reef resources have suffered overexploitation and degradation over the years (Government of Barbados, 1984). In contrast to the wide variety of fish landed in Jamaica, only two species account for more than two-thirds of the Barbados catch, the flyingfish (Hirundichthys affinis) and dolphin fish (Coryphaena hippurus), both offshore pelagic species.

The very different fishery development paths of Jamaica and Barbados are, to a large extent, dicated by the biophysical constraints of their respective marine environments. Jamaica has a large shelf area and extensive reef fishery resources which still remain underutilized in the case of the more distant southern offshore reefs (Munro, 1983). Barbados has narrow shelf and limited reef fishery resources, and this has forced the fishery to expand out to the open sea. Thus, the Barbados fishery has mechanized and moved offshore, while the Jamaican fishery has mechanized incompletely and remained inshore. By the usual fishery development criteria, the Barbados fishery is the more successful of the two: it has modern technology, large boats, large catches. However, the history of fishery development in Barbados raises questions concerning the sustainability of the catch.

## The Sustainability of the Barbados Fishery

The limited reef fishery in Barbados is utilized at a level which is below its potential, not because it is fished insufficiently but because it is overfished and degraded. While much of this degradation has occurred with the tourism boom years of the mid-1960s to the mid-1970s (Truss, 1985], Barbados fishermen were already fishing beyond the shelf area at least as early as the 1940s when they used sailboats in pursuit of the flyingfish. The initial mechanization, complete by the early 1960s, resulted in an increase in landings (Hess, 1961). Although there are no systematic data available, Barbados catch in the 1940s is estimated to be well under 1,000 tons (R.E. Hastings, Fisheries Division, pars, comm.).

The early boats were mostly equipped with 10 HP inboards and had a maximum range of 12 miles framthe island. In the 1960s, 20-40 HP boats appeared, and later in the 1970s, 80-180 HP boats with a maximum range of 40 miles or so became common. The progressive increase in the size of engines (and boats) appears to have come about as a result of higher returns obtained from trips taken progressively further away from thee island. Oxenford and Hunte (1985) reported that landings were positively correlated with boat size and power. Larger boats were capable of covering greater distances, moving from one patch of fish to another, and returning more quickly to markets each afternoon to capture the higher prices earlier in the day.

In 1978, the first long-range boat with an ice hold was introduced. The number of registered "ice boats" increased rapidly from 13 in 1983 to 50 in 1985, according to the records of the Fisheries Division. The introduction of "ice boats" (12-15 m and 120-215 HP) increased the maximum fishing range of the Barbados fleet from some 40 miles to 300 miles, allowing Barbados boats to operate in the waters of Grenada, Trinidad and Tobago. With the "ice boats", the annual Barbados landings jumped from 3,700 tons in 1980-1982 to 6,100 tons in 1983-84.

The development of the distant-water fleet of Barbados may be considered part of a logical progression. "Day boats" had become progressively larger and over-powered for their size, not so much for catching fish but for "racing to the market". Each round of increase in engine size probably brought short-term benefits to the owners who initiated it, until the other owners did the same, so that there was no net benefit to any of them over the long-term. In the meantime, both capital costs and operating costs (especially imported and expensive diesel) were increasing. Since the total landings between 1960 and 1980 did not go up, one can conclude that the overall catch per unit of effort must have been declining, although there is no direct way to demonstrate this.

The development of the "ice boat" is a significant departure from the "dayboat" mode of operation; it eliminates the necessity to race to the market every day. An "ice boat" can be positioned the night before to be the first to land the next day, and with an ice-hoId for 20,000 to 40,000 flyingfish, one boat can flood the local market. This way, the "ice boat" can succeed at the expense of all other boots, just as the higher-powered "day boats" must have succeeded previously at the expense of the smaller boats.

Studies on operational characteristics of Barbados "ice boats" and "day boats" show that the long-range boats use no more Fuel than the ones which return every day. But the total investment of an "ice boat" is about four times higher than a "day boat" (US $ 100,000 vs. $ 25,000), and the operational expenses are higher as well because of expensive ice. Thus, "ice boats" are forced to fish very hard, just to recoup expenses (Berkes and Shaw, in prep.).

From the point of view of sustainability, the crucial question is whether "ice boats" are exploiting different stocks of fish, or whether they are removing fish from a common pool. In the case of dolphin, work by Oxenford and Hunte (1986) indicates that the population exploited around Barbados is the "southern stock" which migrates from the coast of South America in a northwesterly direction through the arc of eastern Caribbean islands. This suggests that the dolphin caught by "ice boats" off Trinidad must be part of the population later fished off Barbados by the "day boats". In the case of the flyingfish, there are not enough data to conclude whether the Barbados "ice boat" fishery is involved in an interception fishery or not (Flyingfish Symposium, 1985).

There are two major risks in the Barbados style of fishery development, radiating from the island in expanding concentric rings of exploitation. Competitive overcapitalization may result in increasingly expensive fish for the island's economy -- unless the boats travelling further afield are indeed exploiting stocks which are otherwise unavailable. If the total Barbados catch, in a few years, returns to levels prior to 1983, then it can be supposed that the increase in 1983 and 1984 was only a short-term phenomenon and not sustainable. Even if the overall catches hold up or increase, the yield performance of the "day boat" fleet should be monitored to ensure that inequity is-not being created by the expansion of the offshore fleet at the expense of the inshore fleet.

The second major risk is political. Barbados is becoming increasingly dependent on fish obtained in other nations' Extended Fisheries Jurisdictions (EFJ). These island states presently lack offshore fleets. They have not moved to exclude Barbados boats from their waters, and yet they clearly have the right to do so (Munro, 19853 . If Grenada, Trinidad and Tobago and other island states should implement their EFJs under the Law of the Sea Convention, Barbados runs the risk of being stuck with an unuseable offshore fleet, as has happened to many nations which took part in the high seas fisheries until the mid-1970s (Warner, 1977).

Sustainabi1ity of the Jamaican Fishery

The Jamaica case is different from the Barbados case in that there *are* no successive waves of exploitation radiating out from the island. Jamaicans have continued to fish much the same waters, and the yields in the early 1980s appeared to be similar to that in 1960. Does this mean that the Jamaican fishery has been sustainable? One complicating factor is that it is not clear if the initial increase and the subsequent decline in the 1960-1970 period, as indicated by official statistics (Fig. 1), is real. If real, one possible explanation is that yields may have temporarily increased following mechanization, only to decline again following stock depletion by 1970. Alternatively, if the real catches have remained stable since

1960, as Sahney(1982) indicates, then one may conclude that the catch per unit of effort must have declined between 1960 and 1980 despite -- perhaps more accurately, because of — fleet development. As with the Barbados fishery, the increase in fishing power does not seem to have been ecologically sustainable.

The Jamaica case is different from the Barbados case in another important way. The overall biological potential of Jamaica's shelf *area* is not yet fished to capacity according to Munro (1983) who estimated the potential at some 16,000 tons/year or about twice the then current landings. But fishing effort is not distributed equally over the area. Much of the underutilized potential exists over the southern offshore banks. By contrast, the north coast with its narrow shelf tends to be heavily utilized. Munro and colleagues had earlier estimated that the maximum sustainable yields for the reef fishery were attained with a fishing intensity of three canoes per square Km of shelf space. Fishing intensity on the north coast exceeded this figure by about 50 percent in the early 1970s, and hence it was recommended that the number of boats be reduced (Munro, 1983, p. 246).

Data for 1981 indicate that the actual number of boats declined slightly (Sahney, 1982), but the fishing effort probably increased on the north coast — due to mechanization. Typically, non-mechanized canoes on the north coast use ten fish traps, but mechanized boats about twenty (Berkes and Shaw, in prep.). Thus, mechanization will result in the doubling of the fishing pressure on reef stocks. While it is true that the fleet has not completely mechanized, the number of outboard-equipped canoes has quadrupled from 500 [ Hess, 1968) in about.

20 years. Is there evidence of overfishing on the north coast? To answer this question, it is necessary to evaluate the Jamaica north coast fishery in the Caribbean regional context.

Using data for 1968, Munro (1983) calculated that the overall yields and neritic species (but excluding oceanic pelagic ones) were 4.2 Kg/ha on the 200 m shelf in the Caribbean region. This figure increased to 8 kg/ha where fisheries were intensive, up to around 14 kg/ha in St. Lucia and Jamaica south coast, reaching a regional top value of 37 kg/ha on Jamaica's north coast. There has been some decline in the north coast catch since then, from 2,300 tons in 1968 (Munro, 1983) to 1,768 tons in 1981 (Sahney, 1982). This decline correlates with increased mechanization and the -apperance of new user-groups, especially spear fishermen, who compete with the traditional trap fishermen over reef fish resources, but causal relationships cannot be established (Berkes and Shaw, in prep.).

From a sustainable management point of view, the continuing high productivity of Jamaica north coast (despite some decline) requires explanation. Munro (1983) recognized that the fishery in this area was particularly intensive by Caribbean standards, but offered no biological explanation for the observed yield levels which were almost ten times the regional average. The explanation may be social in nature and related to local-level management by Jamaican fishermen.

"Fishing beach" is the term used for the landing site of a cluster of boats belonging to a community of fishermen. Each fishing beach surveyed in 1984 on the northcentral coast of Jamaica had its own trap net fishing territory (Berkes and Shaw, in prep.). While the fishermen were quick to point out that, by law, anyone could fish anywhere, in practice they all knew the limits of their own fishing areas. If they set traps beyond their area, they ran a high risk of losing them. If a stranger's trap was found within a community's fishing area, it would probably be removed, damaged or its line cut. The local custom is that a person wishing to fish within an area has to be acceptable to the local community in the first place, even though such a rule has no recognition in law.

This reef tenure system in Jamaican fisheries, with community-based trap fishing territories, is similar to those widely reported from the Pacific region (Ruddle and Akimichi, 1984; Ruddle and Johannes, 1985), but is it the first such report from Caribbean islands and may be unique in that region. It is not possible to prove that the unusually high yields are related to the system of territories, or that the decline since the 1960s is related to factors weakening the authority and homogeneity of communities of reef fishermen. Nevertheless, the territory system is an access control mechanism by which one of the preconditions of the "tragedy of the commons" is eliminated. It minimizes conflict and interference among fishermen sharing a communal fishing groud, and indirectly limits fishing intensity.

Paths to Sustainable Development

The differences in the nature of the commons problem in Barbados and Jamaica indicate that solutions would have to be different also.

The offshore fishery of Barbados is an open-access common resource; it is unowned (res nullius). The physical attributes of the resource is such that it is neither excludable nor divisible (Oakerson, in press); in short, it does not lend itself readily to management by common property institutions. Significantly, the commons problem of the Barbados fishery is international in nature. Both of the two major fish species exploited are international resources requiring regional cooperation in research and management.

All three formulations of the commons problem are relevant for the Barbados fishery. There is a "tragedy of the commons" within the Barbados fishery because the newer, more powerful vessels are successful only at the expense of the older, less powerful inshore boats. Open-access competition has not produced more fish or cheaper fish (imported salted cod was still cheaper than flyingfish), but simply driven up costs, as many of the fishermen themselves are aware. Similar findings have been reported from several Asian fisheries (Panayotou, 1985) . Inefficiencies that result from the open-access management may be solved by the creation of exclusive resource use rights. In the current bioeconomic paradigm of fishery management, this involves limited entry and quota management to prevent the dissipation of resource rent (Clark, 1981; Clerk, 1985; Eckert, 1979),

Fishermen of Barbados not only create externalities for one another, collectively they also create externalities for the fishermen of neighbouring island states. This "international tragedy of the commons" requires the development of international resource management institutions, not an easy task for a diverse group of small island states accustomed to encouraging resource development in the spirit, of open-access management. Perhaps the greatest barrier to regional sustainable development in the Caribbean is the example provided by the affluent nations. Maintaining open-access conditions and increasing the size and number of boats are often considered self-evident goals of fishery management. This is so even though there is good evidence in the case of Barbados that the major constraint in fishery development is not fishing capacity but social and physical infrastructure. Development programs addressing marketing and fishermen's training are likely to provide better returns on investment than further expansion of the fleet (Berkes and Shaw, in prep.).

In contrast to Barbados, the major fishery exploited in Jamaica is the reef fishery, a common property resource (res communes) to which access is controlled by informal, local-level arrangements. The continued high productivity (on a yield per unit area basis) of heavily used areas such as the north coast may partially be explained by the presence of community trap fishing territories. It appears, however, that the catches were even higher when fishing communities were more homogeneous and when motorized canoes did not exist. Increasing the capitalization of the fleet has paradoxically led to lower returns — apparently because the sustainability of the resource was not taken into account in development planning.

This is not to condemn the Jamaican fleet to primitive technology. There are four biologically distinct fishery resource types (in addition to the reef fish community) which may be emphasized for further development., and the exploitation of which may require new technology (Berkes and Shaw, in prep.) . As well, a mechanized distant-water fleet is necessary to exploit southern offshore banks more fully. Thus, there are resources for which new technology and fleet development would be appropriate. The point is that such development is not universally appropriate to all resource types and all areas. In the case of the heavily exploited northern coast fishery where the shelf never extends for more than a couple of km from shore, sail and paddle canoes may indeed be the appropriate technology to exploit the reef fish resource — fully and at minimal cost.

Despite many dissimilarities, there are several emerging generalizations that would apply to both Barbados and Jamaica fisheries. Itemized below as a set of common property resource use principles; these are generalizations likely to be applicable to other fisheries elsewhere and to other kinds of common property resources (National Academy of Sciences, in press; McCay and Acheson, in press; Ruddle and Johannes, 1985; Ruddle and Akimichi, 1984).

(1) The solution of the commons problem starts with the control of access to the resource. In a review of tropical inland fisheries, Scudder and Conelly (1985, p. 34) observed that among traditional management strategies, access limitation has "close to universal" application. Similarly, Berkes (1985) concluded that the "tragedy of the commons" paradigm was not the model of reality for all fisheries mainly because many of these resources were under claims of ownership by communities of fishermen who exercised use-rights and who controlled access to the resource. The granting of limited numbers of

fishing licenses and the assignment of catch quotas to those licenses'! as exercised by central governments in certain developed nations, may also he considered a form of access control to a common property resource (Berkes, 1985).

(2) Increasing production from a common property resource depends on the conservation of the resource base. This restatement of one of the axioms of the World Conservation Strategy is particularly apt here because resources held in common are more susceptible to inadvertent over-utilization than are other resource types. Globally, there is probably a greater loss of marine resources due to overfishing than due to underfishing. Brown (1985, p. 78) has conservatively estimated a loss of 11 million tons due to stock depletion (vs. potentials estimated by the FAO), as compared to a global harvest of 74 million tons in 1983. In the case of Barbados reef fisheries, this principle has recently been recognized; it is government policy to increase production by protecting the coral reef environment (Truss, 1985).

(3) The sustainable utilization of a resource is closely connected to the use of appropriate technology for the harvest of that resource. Just as it is possible but not advisable to use a chainsaw to cut butter, it is not advisable to use expensive, large-scale fishing technology to harvest inshore fish which can be readily harvested with inexpensive, small-scale technology. There is an important social dimension of this principle. The local resource community tends to use locally appropriate small-scale harvesting technology, whereas new technology is often in the control of outsiders who want to "mine" the resource. Many resource use conflicts

involve such confrontations between local users vs. outsiders with more efficient (and non-sustainable) harvesting technologies at their disposal (Dasgupta, 1982). Conflicts between trawlers and small-scale inshore fisheries, as occurs in many parts of the world, may be considered a symptom, in part, of the use of inappropriate technology by some groups.

(4) Local-level management improves prospects for the sustainable use of a common resource. The comparative case study approach shows that successful management occurs when relatively smell and homogenous group of users are able to control the access to the resource and institute their own local-level management institutions (Berkes, in press; Wade, in press). Why is the local community important? Ostrom (in press) summarized the multiple functions of the simple rule, "you must live in this community to use this resource": it is easy to learn and to transmit, encourages the development of local Knowledge of the resource, enhances possibilities for reciprocity, reduces decision-making costs, and reduces enforcement costs. In the Prisoner's Dilemma context, the key feature of a "resource community" is that there are repeated encounters among users, the precondition of reciprocity in the evolution of cooperation (Axelrod, 1984). In the "tragedy of the commons" context, suffice to say that a resource community often develops social sanctions to ensure that the long-term community interest is not sacrified for short-term individual gain,

## Summary and Conclusions

The important lesson of common property resources is that the development and sustainable use of resources, the lasting satisfaction of human needs, local involvement in development planning and management decision-making, and environmental conservation in general are all interconnected issues. The control of access to the resource is the beginning of the solution to the commons problem. This need not necessarily be done by creating private property. In summing up the National Academy of Sciences conference, Ostrom (in press) recommended to development planners that "they abandon current presumptions that local rules and customs are lacking for most common-pool resource systems". The replacement of common property with private property (or with exclusive resource rights) is not the only possible approach (Regier and Grima, 1985; National Academy of Sciences, in press).

Many developing nations have rich traditions of local-level resource management systems. These should be considered "national resources" of a kind and cherished. As Panayotou (1982, p. 48) puts it, "the revival and rejuvenation of traditional customary systems...with limited but crucial government involvement is one of the most promising policy options for upgrading and managing artisanel fisheries". In the past, this option was ignored often only because it does not fit with the dominant, market-oriented resource management notions of the Western World (Bromley, 1985). Yet these nations themselves *are* abandoning open-access management of common property resources. To achieve sustainable development, it is important to discard failed systems or to avoid them in the first place.

That there is more than one way to solve the commons problem poses both problems and opportunities. Problems because there are no quick fixes and no easy way to transfer technology to solve these problems. Yet there are opportunities because this may be one area in which developing nations and traditional societies have a point or two to teach industrialized nations about resource management. It is now possible to formulate principles of common property resources, as done here and elsewhere. How these principles can be developed into practical frameworks for the sustainable development of particular resource types in specific parts of the world is the continuing challenge for all resource managers, decision-makers and development planners.

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Figure 1.
Total marine catch for Jamaica (above) and Barbados (below) according to data made available by FAO.