CHAPTER 5

CAN ECOTOURISM BE AN ALTERNATIVE TO TRADITIONAL FISHING?

An analysis with reference to the case of the Saloum Delta (Senegal)

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Abstract. This paper analyses the possible economic consequences of the development of ecotourism on fishing communities of poor countries from two complementary points of view: an empirical survey of a case study, and a bioeconomic model. It is divided into three parts. The first part of the paper is dedicated to the case of the Saloum delta, Senegal, an area where demographic pressure and an agriculture crisis have led to a sharp increase in fishing effort resulting in overfishing, and where attempts have been made to provide alternative income to the local population through ecotourism. The second part of the paper presents a two-sector bioeconomic model, where the link between artisanal fishing and ecotourism relies on their common use of the same natural resource. According to this model, developing ecotourism may help to overcome the dilemma between the need for long-term resource conservation and the immediate necessity to provide jobs and income to the local population. However, due to the negative externality exerted by fishing on ecotourism, the model suggests that this development is likely to be non-optimal if it is left to the initiative of market forces. The last section of the paper discusses the practical significance of these conclusions, with reference to the Saloum delta case. It underlines the major limits of the model, including the assumed non-extractive character of ecotourism, and its lack of spatial dimension.
Keywords. ecotourism; fisheries management; Saloum delta

INTRODUCTION

In many developing countries, a large part of the economy still relies on the exploitation of renewable natural resources, among which fish stocks. For these countries, fishing may represent an important source of foreign currencies, but also of employment, income and animal proteins (Loayza and Sprague 1992; FAO

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2004). However, poverty, demographic pressure and, in many cases, access conflicts and uncontrolled harvesting by foreign fleets frequently result in overfishing, which jeopardizes the potential of sustainable development of the national economy. In this type of situation, social pressure makes it very difficult to enforce conservation policies as short-term considerations are given an absolute priority. Developing non-extractive uses of the ecosystem, such as ecotourism, is frequently recommended as an alternative. The aim is to make ecosystem conservation a source of economic benefits, not only in the long run, but also for the present time.

In this paper, we first illustrate the relations between fishing and ecotourism through the case study of the Saloum delta (Senegal). We then analyse these relations in more general terms, by means of a bioeconomic model describing the interactions between two uses of the same natural resource, one of them being extractive (fishing) and the other non-extractive (ecotourism). Finally, we discuss the conclusions of the model, making use of some empirical evidences derived from our case study.

AN ILLUSTRATION: THE CASE OF THE SALOUM DELTA (SENEGAL)

The Saloum delta is located in the Sine-Saloum country, Senegal (Figure 1). It covers an area of approximately 5,000 square kilometres, representing 2.5% of the total surface of the country. The delta ecosystem is particularly rich in terms of biodiversity, which led to its classification as a national park in 1976 and a Biosphere Reserve by the UNESCO in 1981. It is also a densely populated area, with about 610,000 inhabitants in 1997, representing an average of 122 persons per km^2 and 7% of the total population of Senegal. Moreover, demographic pressure in the delta is growing fast, with a 2.8% annual increase in population (DPS 2001; Dia 2003).

Agriculture, which is the major economic activity in the Sine-Saloum, has undergone a long-lasting crisis caused by a combination of natural, demographic and economic factors (drought, fast population increase, inequal access to land, fall in the export price of peanuts). As a result, farmers were induced to diversify their activity towards artisanal fishing, a move that was eased by the weakness of economic and institutional barriers to entry into this industry (Cormier-Salem 2000; 2006). The number of canoes in activity rose from 1,200 in 1972 to 1,800 in 1978. Estimated yearly landings, which were around 20,000 at the beginning of the decade, reached a maximum of 50,000 tons in 1978 (Figure 2). This peak was soon followed by a sharp decline and, during the 1990s, annual landings fluctuated around 10,000 tons (data source: Marine Fisheries Authority, Dakar). The decrease in the number of canoes was more limited (around 1,600 units were active in the late ’90s), and was probably offset by the increase in individual fishing power due to technical progress. According to various studies, several species are clearly overfished (EPEEC 1998; Diouf et al. 1998; Ducrocq 1999).

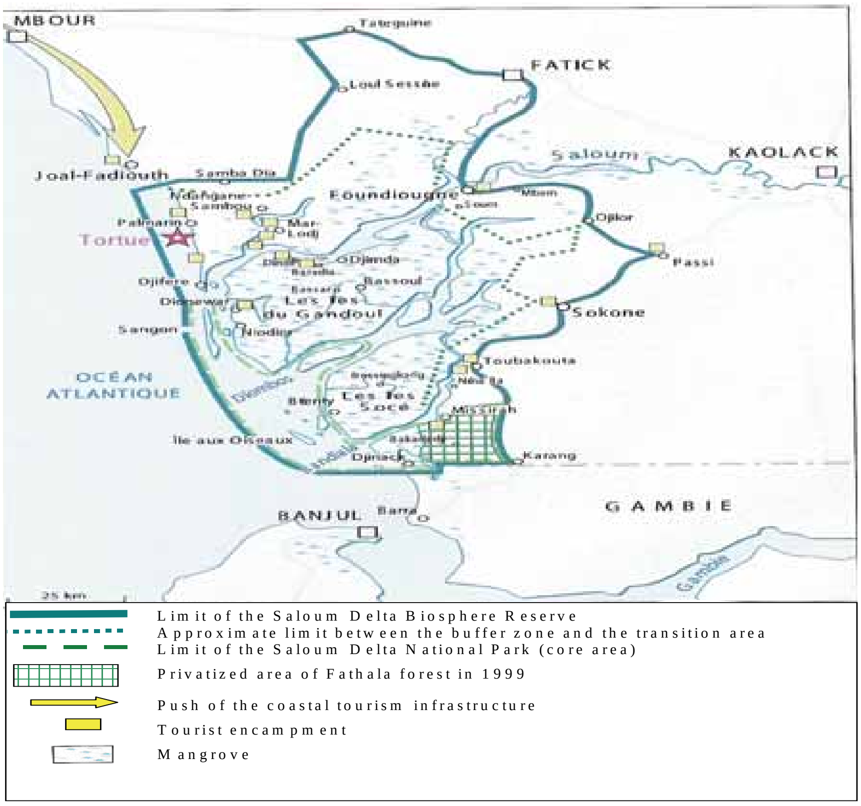

Figure 1*. Map of the Saloum delta (Source: Cormier-Salem 2003)*

In order to protect the estuarine ecosystem, a national park was created in the Saloum delta in 1976. Since that date, tourism has grown fast in the area (Figure 3), which is now the fourth tourist zone of Senegal: between 1975 and 2002, the accommodation capacity rose from 108 to 1,178 beds, and the yearly number of overnight stays rose from 5,181 to 44,327. In 2002, the local tourism industry turnover amounted to approximately 75% of the value of fish landings (data source: Ministry of Tourism, Dakar).

A field survey was carried out in 2003 in order to assess the factors influencing frequentation of the area by tourists and the socioeconomic impact of tourism on the local population (Sarr 2005). This survey covered hotel and holiday resort managers, their customers and local villagers (with emphasis on fishermen). According to the survey results, the fact that the delta is a marine protected area (MPA) is a major attraction factor for tourists: 34% mentioned it as the first motivation for their visit to the area. This feature is confirmed by the nature of their activities during their stay, which are clearly related to the state of the ecosystem: the two main activities

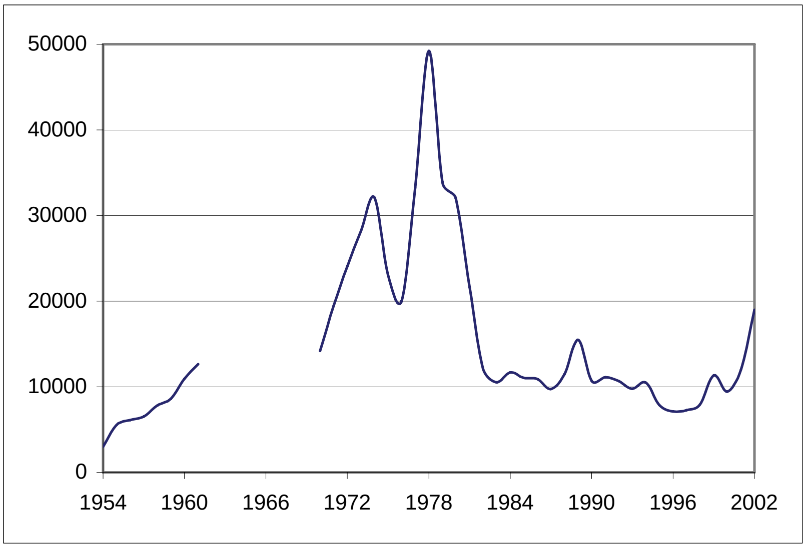

Figure 2*. Evolution of fish landings in the Saloum delta, 1954-2002 (Source: From the data of the Direction des Pêches Maritimes)*

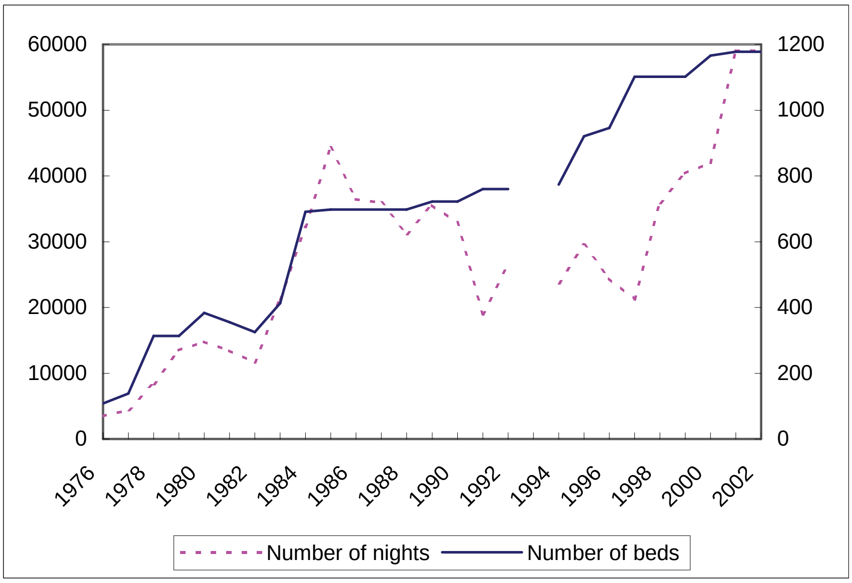

Figure 3*. Tourism in the Saloum delta: evolution of the accommodation capacity and of the number of yearly overnight stays, 1976-2002 (Source: From the data of the Ministère du Tourisme)*

declared by tourists are canoe trips in the delta (which shelters important populations of birds) and sport fishing (which is in principle non-extractive, insofar as the fisher releases his catches). These activities offer small-scale fishermen an opportunity to benefit from the presence of tourists, by providing services of transportation and tourist guides in the delta. According to survey results, 15% of the motorized canoes in the delta are involved in these activities. For the population of the area, the incomes generated by these services are added to the wages paid by hotels and holiday resorts to their local employees (8 permanent jobs per firm on average, according to the survey), and other incomes derived from the presence of tourists such as the sale of handicrafts.

A DIVERSIFICATION MODEL

In this section, we formally investigate the relation between artisanal fishing and ecotourism, with the help of a bioeconomic model. Let industry 1 be the fishing industry, and industry 2 the ecotourism industry. Both industries are assumed to rely on the same natural resource. However, they do not use it in the same way: unlike industry 1, industry 2 is non-extractive. We first present the relationships describing the production activity in each industry, and then we turn to the incomes and jobs they generate. Finally, we analyse the interaction between industry 1 and industry 2, and investigate the incidence of this interaction on social welfare.

Production

In the case of industry 1, the output is fish catch. For the sake of simplicity, we consider the local fish resource homogeneous. We use a model derived from the standard Gordon-Schaefer model to describe the links between fish stock, fishing effort and catch (Gordon 1954; Schaefer 1957; Clark 1976). This model relies on two basic relationships, describing the stock dynamics and the fishing technology.
The dynamics of the fish stock are due to natural dynamics and fishing mortality:

$$\frac{dX}{dt} = g(X) - Y_1 \tag{1}$$

where:

- X is the fish stock biomass;
- g is a function describing the natural dynamics of the stock;
- Y_1 is the volume of catch by fishermen.

Let K be the carrying capacity of the ecosystem, and X_0 a level of X belonging to the open interval $]0\,;K[$. Function g is assumed to be positive for $X < K$, increasing if $X < X_0$, and decreasing if $X > X_0$ (in the basic Gordon-Schaefer model, g is quadratic, and $X_0 = K/2$).

With regards to fishing technology, the catch per unit of effort (CPUE) is supposed to be proportional to fish abundance:

$$\frac{Y_1}{E_1} = qX \tag{2}$$

where:

E_1 is fishing effort;
q is a positive parameter ('catchability coefficient') reflecting the efficiency of the fishing technology.

Combining (1) and (2), and assuming biological equilibrium ($dX / dt = 0$), we get the following relationships between fishing effort and the corresponding stabilized levels of fish biomass and catch:

$$X = X_s(E_1) \quad \text{with} \quad X_s{}'(E_1) < 0 \tag{3}$$

$$Y_1 = qE_1X_s(E_1) = h(E_1) \quad \text{with} \quad \begin{cases} h'(E_1) > 0 & \text{for} \quad X_S(E_1) > X_0 \\ h'(E_1) < 0 & \text{for} \quad X_S(E_1) < X_0 \end{cases} \tag{4}$$

In the case of industry 2, the output is the flow of tourists visiting the area. Like fish landings in the case of industry 1, this output is the result of a combination of a natural factor (fish biomass X) and of an anthropogenic factor (attraction effort E_2):

$$Y_2 = f(X, E_2) \tag{5}$$

We assume that f is a standard production function, with substitutable factors and positive but decreasing marginal productivities. As a result, for a given level of X, Y_2 is an increasing and concave function of E_2.

Incomes and jobs

In each industry, the resource rent is defined as the surplus of revenue over effort cost, assuming constant prices and biological equilibrium of the natural resource:

$$\pi_1 = P_1h(E_1) - C_1E_1 \tag{6}$$

$$\pi_2 = P_2 f(X_s, E_2) - C_2E_2 \tag{7}$$

where:

P_i is the unit price of output in industry i ($i = 1, 2$);
C_i is the unit cost of effort in industry i ($i = 1, 2$).
(both P_i and C_i are assumed to be exogenous)

Note that ecotourism rent (π_2) is a function of two variables (X_s and E_2), while fishery rent (π_1) is a function of one variable only (E_1).

Employment in each industry is related to the level of effort. For the sake of simplicity, let us assimilate these two concepts. As a result, the total level of employment generated by the two industries is the sum of E_1 and E_2.

Suppose that open access prevails in the fishery, unemployment is high and no alternative job is available in the area. Fishing effort will then increase up to the point where rent is totally dissipated (open-access equilibrium). Setting π_1 to zero in (6) and solving for E_1 provides the open-access equilibrium value of fishing effort ($\tilde{E}_1$). Corresponding values of stock and catch are then obtained through (3) and (4) (Figures 4 and 5).

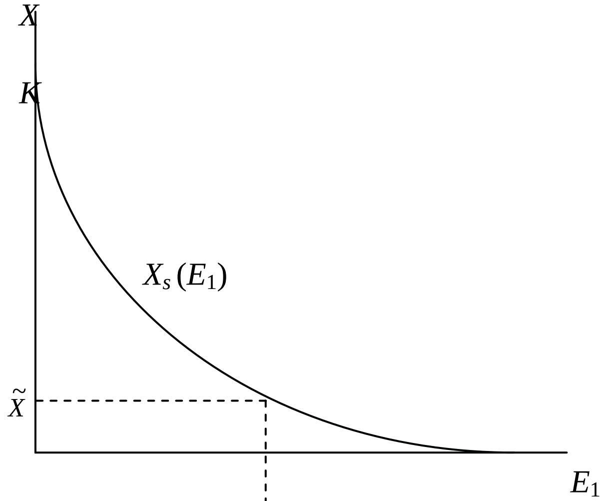

Figure 4. *Relation between fishing effort and equilibrium stock biomass*

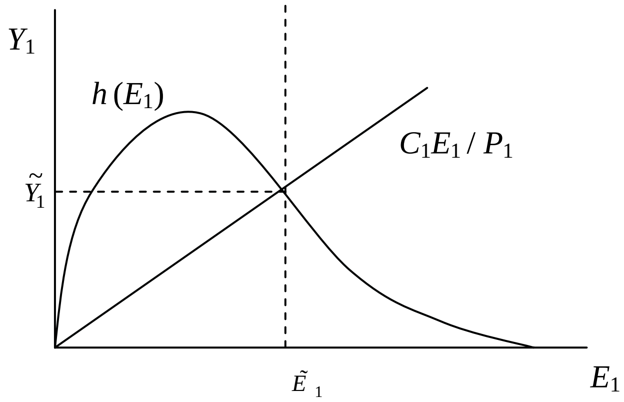

Figure 5. *Relation between fishing effort and equilibrium catch*

If the total available manpower E is larger than $\tilde{E}_1$, the fishing industry cannot provide jobs to everyone. The socioeconomic situation combines rent dissipation and unemployment. Under these circumstances, developing ecotourism would generate several benefits:

1. It would generate additional jobs. If open access prevails in both industries, the maximum capacity of employment in the ecotourism industry ($\tilde{E}_2$) is such that:

$$\frac{f\left(X_s(\tilde{E}_1), \tilde{E}_2\right)}{\tilde{E}_2} = \frac{C_2}{P_2} \tag{8}$$

This condition corresponds to full rent dissipation (Figure 6). As a result, total employment may rise from $\tilde{E}_1$ up to $\tilde{E}_1 + \tilde{E}_2$, provided enough labour force is available.

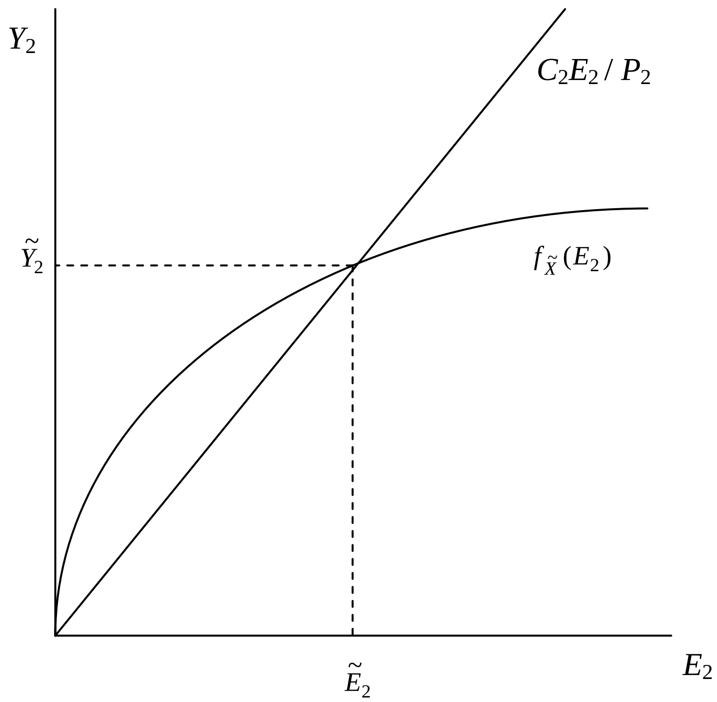

Figure 6*. Relation between effort and output in the ecotourism industry, assuming open access in the fishing industry ($X = \tilde{X}$)*

2. It might generate economic rents, not only in the ecotourism industry, but also in the fishing industry. This will be the case, even under open access, if E, though

being larger than $\tilde{E}_1$, is smaller than $\tilde{E}_1 + \tilde{E}_2$. Under these circumstances, industry 2 cannot reach open-access equilibrium. Ecotourism generates a positive rent, which is likely to attract some labour force from the fishing industry, thereby alleviating the pressure on the fish resource. As a result, some positive rent also appears in industry 1. The condition of equilibrium between the two industries is then:

$$\frac{d\pi_1}{dE_1} = \frac{\partial \pi_2}{\partial E_2} \tag{9}$$

which corresponds to the maximization of private profitability of effort (if the marginal profitability of effort was higher in one industry than in the other, it would be profitable for producers engaged in the second industry to redistribute part of their effort towards the first one). The corresponding values of E_1 and E_2 are obtained by combining (3), (6) and (7) with (9) and the global effort constraint ($E_1 + E_2 = E$).

However, such a distribution of effort is unlikely to be optimal from a social point of view. This is so because industry 1 exerts a negative externality on industry 2, due to the impact of fishing mortality on the resource that is jointly exploited by the two industries.

Externality

Assuming stock equilibrium and combining (3) and (5), we get:

$$Y_2 = f\big(X_s(E_1), E_2\big) \qquad \text{with} \qquad \frac{\partial Y_2}{\partial E_1} = \frac{\partial f}{\partial X}\frac{dX_s}{dE_1} < 0 \tag{10}$$

This relationship illustrates the negative stock externality exerted by industry 1 on industry 2: when fishers increase their effort, the equilibrium level of fish stock is reduced, which in turn affects negatively the output of ecotourism, for a given level of effort in this activity (Figure 7).

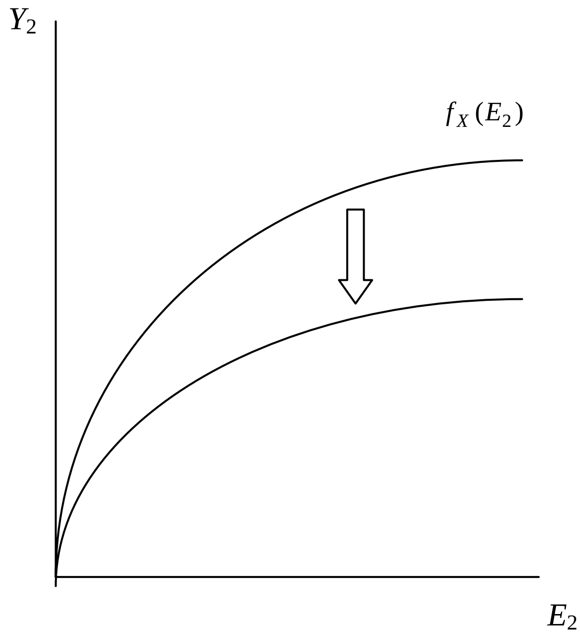

Figure 7. *Impact of an increase in fishing effort on the effort / output curve in the ecotourism industry ($\Delta E_1 > 0 \Rightarrow \Delta X_s < 0$)*

This externality generates a gap between the private marginal profitability and the social marginal profitability of fishing effort. The latter not only includes the impact of the variation of fishing effort on fishery rent, but also the impact on ecotourism rent, due to the resulting change in the equilibrium level of the natural resource:

$$\frac{d\pi_1}{dE_1} + \frac{\partial\pi_2}{\partial E_1} = \frac{d\pi_1}{dE_1} + \frac{\partial\pi_2}{\partial X}\frac{dX}{dE_1} \qquad (11)$$

As derivative dX/dE_1 is negative, we get:

$$\frac{d\pi_1}{dE_1} + \frac{\partial\pi_2}{\partial E_1} < \frac{d\pi_1}{dE_1} \qquad (12)$$

which means that the social marginal profitability of fishing effort is smaller than its private marginal profitability.

Now, assuming the two industries may provide employment to the entire available labour force, the socially optimal distribution of effort between these industries is the vector (E_1 , E_2) maximizing ($\pi_1 + \pi_2$), submitted to the constraint ($E_1 + E_2 = E$). As the ecotourism rent depends also on fishing effort (see (7)), the first-order conditions of this constrained maximization program lead to:

$$\frac{d\pi_1}{dE_1} + \frac{\partial\pi_2}{\partial E_1} = \frac{\partial\pi_2}{\partial E_2} \tag{13}$$

i.e., to the equality between the *social* marginal profitability of effort in industry 1, and the marginal profitability of effort in industry 2. Combining (12) and (13), we get:

$$\frac{d\pi_1}{dE_1} > \frac{\partial\pi_2}{\partial E_2} \tag{14}$$

which is not consistent with (9), the equilibrium condition corresponding to private profitability maximization. More specifically, the level of fishing effort that is optimal from a social point of view is smaller than the one that is optimal from a private point of view.

DISCUSSION

The model in the previous section supports the idea that, in a heavily exploited fishery, developing a non-extractive activity such as ecotourism may help to overcome the dilemma between the need for long-term resource conservation and the immediate necessity to provide jobs and income to the local population.

It is worth noting that no restriction on catches or fishing effort was assumed in the model. Such a situation corresponds fairly well to that of many poor countries, where enforcing this type of regulation on artisanal fishing is quite problematic. In the Saloum delta for instance, notwithstanding the status of MPA of the area (national park and biosphere reserve), access of artisanal fishers to fish resources remains close to open access (Sarr 2005). Hannesson pointed out that, even with a strictly enforced no-take zone, an MPA cannot generate economic rent as long as open access to fish stocks prevails in the fishing zone (Hannesson 1998). However, his analysis was restricted to the case where the only use of fish resources was fishing, and assumed that the potential increase in fishing effort was virtually unlimited. In contrast with these assumptions, our model assumes that fishing may be combined with a non-extractive use of fish resources, and that the potential development of cumulated effort in both industries is limited. As a result, even if the available labour force exceeds the level of employment corresponding to open-access equilibrium of the fishery, developing ecotourism may generate a rent and may also help to restore part of the fishery rent by alleviating the fishing pressure on the stock. This result, indeed, holds only as long as the cumulated absorption capacity of the two industries can match the available labour force (which is questionable in many areas, including the Saloum delta). Otherwise, rent will be dissipated in both industries and unemployment will appear. However, in this case, rent dissipation is partly spurious: the opportunity cost of labour is locally zero, which implies that what is registered as effort cost is, in fact, resource rent, i.e., a net contribution to social welfare (at least for that part of effort which corresponds to direct labour).

The model also suggests that the potential benefits of ecotourism for the population might suffer from the impact of fishing on the resource: if the distribution of effort between the two activities is simply regulated by the market, it will not be efficient (Pareto-optimal), because fishing generates a negative stock externality towards ecotourism. Unless internalized, this externality favours an excess development of the first industry compared to the second one, which results in a loss of social welfare. This result calls for a public policy limiting fishing mortality or providing some help to the development of ecotourism. Although several serious reasons speak for the first solution, the social and technical problems related to its implementation may induce governments to adopt the second one. A policy mix combining both approaches could be a pragmatic compromise.

However, our model relies on several simplifying assumptions, which may limit the practical significance of the conclusions that can be derived from it. These assumptions concern each industry considered separately as well as the link between them.

The simplifying assumptions underlying the fisheries component of the model have been thoroughly analysed in the literature (e.g., Hannesson 1993) and will not be recalled here in detail. The most drastic one is probably the treatment of fish resources as a homogeneous stock, disregarding the variety of species targeted by fishermen and the differences between age classes within each species. The powerful impact of environmental variations on recruitment also suggests that assuming a deterministic relationship between the state and time variation of the stock is oversimplifying.

Regarding the ecotourism component of the model, the most questionable simplifying assumption is probably the exogenous character of price. Unlike the output of the fishing industry, the output of the ecotourism industry is not standardized, which implies that monopolistic competition is more relevant than perfect competition for the modelling of this industry. This type of modelling requires taking into account the customers' behaviour and their sensitiveness to price (Deyak and Smith 1978; Anderson 1983; Bhat 2003).

The interrelation between fishing and ecotourism is highly stylized in the model. It is based on the assumption that both industries make use of the same resource, one use being extractive (fishing) while the other is not (ecotourism). This assumption is questionable in several respects. Though both fishing and ecotourism obviously depend on the ecosystem, it does not follow that they make use of the same component of the ecosystem as a production factor: increasing fish biomass does not necessarily attract tourists. It probably does in places, like coral-reef areas (Dixon et al. 1993), with a high potential for recreational activities such as scuba diving and snorkelling (though, in this case, other factors are to be considered, like fish assemblages, presence of emblematic species, or types of fishing and their impact on fish behaviour). In other places, the link between fish abundance and ecotourism is indirect, taking the form of a biological interaction between fish and other species that are attractive for tourists, like seabirds or marine mammals (Boncoeur et al. 2002). This feature probably fits better to the case of the Saloum delta, where important populations of birds attract tourists. However, in this place, the most direct link between fish abundance and tourism is sport fishing. This activity, just like any other kind of fishing, is by itself extractive, and the reference to 'no-kill' practices certainly cannot be taken as a guarantee that it has no impact on fish resources (extended to marine ecosystems, a similar caveat applies to allegedly 'non-extractive' activities like scuba diving or snorkelling). Under such circumstances, it would be necessary to replace the one-way externality of our model by a mutual externality between the two industries, each of them negatively affecting the other by its impact on fish resources (just like individual fishermen do when they harvest the same stock). However, the assumption of a one-way externality may be kept as an approximation if the impact of industry 2 on fish resources is significantly lower than that of industry 1, for the same level of income generated. Empirical evidence seems to back this view: the level of resource rent by kg of fish harvested is usually much higher in the case of sport fishing than in the case of professional fishing.

Even if the relationship between the two industries in the model may be considered a reasonable first-order approximation of real-world stock externalities, this model is likely to give only a partial view of the interactions between artisanal fishing and tourism, because it is not spatially explicit (other types of interaction between local population and tourism – for instance of cultural character – are not considered here, because they are not specific to the fishing industry). Interactions between fishermen and tourists often have a spatial dimension, because their respective activities cannot be exerted in the same place at the same time. This happens for instance in the Saloum delta, when nets set by fishermen across arms of the estuary (so-called "bolongs") stand in the way of boats carrying tourists. Under such circumstances, conflicts may arise between the two activities, the stake being the control over space. Solving this type of conflict is supposed to become easier if participatory mechanisms are embedded in coastal-zone management, and, to this end, governance indicators play an increasing role in the monitoring of MPAs (Pomeroy et al. 2004). However, empirical evidence suggests that, in this field, reality may lag far behind flaunted principles (Sarr 2005).

Aside from considerations concerning the style of governance, possible use conflicts between fishing and tourism and solutions to these conflicts cannot be investigated without taking into account the distributional consequences of the development of the tourism industry, a dimension that is not included in our model. The major case for the development of tourism in a poor country is the benefits it is supposed to generate for the local population, in terms of jobs and income. It is therefore critical to assess how much of the rent generated by tourism is left to the local population.

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