Pergamon

World Development Vol. 27, No. 5, pp. 773–788, 1999

0305-750X/99/$ – see front matter

PII: S0305-750X(99)00026-1

The Ambiguous Impact of Inequality on Local Resource Management

JEAN-MARIE BALAND and JEAN-PHILIPPE PLATTEAU *
University of Namur, Belgium

Summary. — The impact of inequality on the ability of human groups to undertake successful collective action is investigated with special reference to overexploitation of common property resources. In voluntary provision problems, on the one hand, inequality has an ambiguous impact on the feasibility of the efficient outcome even though better endowed agents contribute more to collective action. In regulated settings, on the other hand, inequality tends to reduce the acceptability of available regulatory schemes and, therefore, to make collective action more difficult. © 1999 Elsevier Science Ltd. All rights reserved.

1. INTRODUCTION

Increasingly during the last decades, the development literature has emphasized the important role of social groups and communities to solve a wide range of economic problems that neither the market nor the state can effectively tackle alone. These problems include the production of local public utilities, the internalization of ecological externalities, the guaranteeing of credit risks *vis-à-vis* formal lenders, the insurance of poor people against various kinds of contingencies, etc. (see, for instance, Hayami and Kikuchi, 1981; Kimball, 1988; Udry, 1994; Coate and Ravaillon, 1993; Fafchamps, 1992; Platteau, 1991; Ostrom, 1990). The question as to which factors are more conducive to successful collective actions has therefore recently received a lot of attention from a large number of scholars in different social sciences. Probably the most salient conclusion which emerges from these works, including the works of economic theorists, concerns the crucial role of group size: the smaller the group the stronger its ability to perform collectively (for recent surveys, see Hardin, 1982; Sandler, 1992; Baland and Platteau, 1996).

A more debatable issue concerns the role of inequality. While this issue has been largely obfuscated in many field studies because it was confused with that of the group size (a small group tends to be considered as effective largely because it is homogeneous), there has recently been a flurry of writings examining the impact of inequality *per se* on collective action. The way was opened in the mid-1960s when Olson (1965) contended that more inequality may favor the creation of public goods. Other authors have followed suit by showing the positive role of inequality in a wide variety of fields of economics. For instance, oligopolistic collusion, military alliances, international responses to terrorism, or regional schemes for economic integration may be facilitated by the existence of a large firm or country; the presence of a dominant shareholder may limit free-riding in the monitoring of managers by shareholders; the participation of well-off farmers in rural cooperatives may enhance their efficiency, etc. (see, e.g., Sandler and Forbes, 1980; Olson, 1982; Sandler, 1992; Braverman *et al.*, 1991). Of late, some sociologists who have adopted an individual methodological approach have also

* We would like to thank for their helpful comments Pranab Bardhan, Jean Drèze, Badel Mukherji, Brent Swallow, Alain de Janvry, Elisabeth Sadoulet, Jeff Dayton-Johnson, Maurice Shiff, Sam Bowles, Jim Boyce, Katie Baird and participants to various seminars in which this paper has been presented (Delhi School of Economics, January 1995, ILRI, Nairobi and ILRI, Adis-Ababa, April 1995, Berkeley, September 1995, Amherst, May 1996) as well as two anonymous referees and an editor of this journal. Financial support from the MacArthur Foundation is gratefully acknowledged. Final revision accepted: 30 September 1998.

started to investigate the same issues and their discussions bear strong similarity to those found in the economic literature (see, in particular, Oliver *et al*., 1985; Oliver and Marwell, 1988; Heckathorn, 1993).

The purpose of this paper is to clarify the contribution that economic theory can make toward understanding the impact of inequality on the prospects of collective action with specific reference to the use of common property resources. More precisely, we will argue that there exist a number of critical factors that determine whether inequality promotes or discourages collective action, particularly those aimed at preventing overexploitation of natural resources. In order to make the presentation more vivid, whenever possible, the various points will be illustrated by referring to a range of concrete situations where collective action is aimed at managing such resources. In this way, findings from in-depth case studies conducted by social scientists will be linked up to economic reasoning.

The paper is made of three sections. In Section 2, we discuss various conceivable ways in which inequality in wealth distribution can affect the prospects for collective action in the commons. In Section 3, attention is focused on the effects of inequality in decentralized settings while in Section 4 the possibility of social regulation is allowed for. Modes of regulation in which inequality matters most receive primary attention. A final section briefly summarizes the main findings. It must be noted that in this paper the approach followed will be largely illustrative in the sense that many points that we want to make will be supported by numerical illustrations rather than by formal proofs. The reader interested in those proofs will find them in a two-part companion paper (Baland and Platteau, 1997, 1998).

2. INEQUALITY IN THE CONTEXT OF THE COMMONS

As will become clear in the following sections, the dominant economic approach to collective action in a common property resource (henceforth called CPR) consists of analyzing the individual incentives to contribute. Such incentives are determined by the private benefits and costs resulting from participation in collective action. In a static perspective, the distribution of benefits reflects the distribution of rights of access to the CPR which is itself influenced by the distribution of wealth endowments.[1] Thus, some users enjoy better access to the CPR because they possess a relatively large amount of the production factors required to exploit it (capital equipment, control over labor power, better skills and knowledge, etc.). This advantage may originate in past accumulation of wealth, greater network of social relations, better education, or in a privileged access to markets where critical inputs such as credit and manpower can be obtained. In reality, many of these factors are narrowly interlocked. To take the example of credit, influential individuals are often found to gain a disproportionate share of the funds available because they have better collaterals to offer, greater trustworthiness, stronger connections with leading persons in credit-giving agencies or better information about available credit opportunities. Regarding labor, their enviable position may result from the fact that they have sufficient cash to pay advance money or give consumption credit to hired workers, that they have many social relations or large families to rely on, etc.

Furthermore, when collective action involves active steps to conserve the resource, costs are usually incurred in the current period while benefits only come later. The present value of the net expected benefits depends on the structure of the users' time preferences. Thus, those with a shorter time horizon typically adopt strategies which yield more immediate results, and disregard longer-term considerations in resource conservation.

Variations in time horizons are actually related to the initial distribution of wealth either through the intervention of survival constraints or through the availability of outside economic opportunities. First, the level of wealth of the poorer users may be so low that their participation in collective action violates their survival constraint. This constraint artificially reduces their time horizon since they are forced to attach considerable importance to their present incomes. As a result, they are not willing to undertake conservation investments or endure present sacrifices in the form of self-restraint in the use of the resource even though such actions would increase their future permanent income.[2] A second reason why rates of time preference may vary among CPR users lies in the fact that some of them may have better access to outside economic opportunities than others. For those enjoying such opportunities, the discounted value of their future income

flows from the CPR may, at some point in time, fall below that of alternative incomes available. Since they anticipate that they will then shift to the alternative occupation, they have an incentive to overexploit and deplete the CPR. On the contrary, users deprived of such outside opportunities attach a higher value to the future state of the resource.

The relation between wealth distribution and outside opportunities is actually ambiguous. Indeed, on the one hand, rich people usually have easier access to alternative opportunities due to their better endowments in human and social capital and access to financial markets. On the other hand, owing to their low resource base, poor people may be forced to actively seek outside employment. When taking up outside occupations, however, rich and poor people still behave differently with regard to the CPR. Indeed, the employment prospects for the poor are often so uncertain that they are keen to preserve the local CPR as a hedge against the risk of unemployment. A widespread strategy to this end consists of migrant workers leaving the core of their family in the native village to protect the CPR and their rights of access to it. By contrast, rich migrants tend to move permanently to new locations and cut off their ties with the native village.

3. COLLECTIVE ACTION IN DECENTRALIZED SETTINGS

By decentralized settings we mean situations in which agents freely interact without any intervention by a regulatory authority. In the following discussion, we will assume that interindividual transfers are impossible, a reasonable assumption in the case of local resource management problems (for more details on this point, see Baland and Platteau, 1996). It is also assumed that there is a well-defined group of a restricted number of users entitled to exploit a given CPR. Contrary to the case of open access where competition between many users drives them to dissipate the whole resource rent (since they decide to enter and exploit the resource as long as the net expected benefit from doing so is positive), users here interact strategically with each other. In other words, they no longer think of the final outcome as independent of their own individual decisions. When they make their decision, they take into account the intensity of harvesting effort decided by the other agents. As all users behave in this manner, decisions in this case are strategically interdependent. The appropriate analytical framework to analyze such interdependent decision-making is noncooperative game theory. The final outcome of strategic interactions is said to be in a Nash equilibrium when given the strategies followed by all other users, an individual's best response is not to deviate from his chosen harvesting effort. In the first subsection, we first illustrate Olson's argument according to which large resource users tend to be more concerned by the resource and therefore have more incentive to contribute to collective action on the resource. As cooperation by small resource users may also be needed, however, inequality may also destroy collective action by giving those users too small incentives to cooperate. This case will be discussed in the second subsection.

(a) *The role of inequality when marginal productivity of effort decreases*

The characteristics of the technology used under common property crucially affects the way inequality bears upon collective action. To show this, different cases will be discussed. In a first step, we consider the situation of a CPR in which the production function is concave in the variable factor: the marginal productivity of harvesting effort decreases as the total amount of effort increases.

For example, let us look at the problem of a fishery in which a fixed number of fishermen (say, four people) freely decide the number of boats to put out at sea. Each of them has free access to the fishing ground. The fishermen's choice will typically be based on a comparison between the price of entry which they have to bear (say, the rental price of a fishing gear) and the expected income. As long as the net expected benefit on their own gears is positive, they decide to put in an additional unit of fishing effort. Since marginal productivity is decreasing, any such move imposes a negative externality on the other fishermen by reducing the amount of fish caught by pre-existing fishing units (a declining marginal productivity implies a decreasing average productivity). Total net income, or profit, is defined as the difference between the value of aggregate catches and the total operating costs obtained by multiplying the number of boats and their unit price assumed to be equal to one. The relationship between the total number of boats, total output, total profits and average profit per boat is given in Table 1.

Table 1. *Relationship between total level of appropriation efforts and total profit on a CPR with decreasing returns*

# of boats	1	2	3	4	5	6	7	8	9	10	11
Total output	2	8	12	15	17	17.5	17.6	17.1	16.3	15.5	11.55
Total profits	2	6	9	11	12	11.5	10.6	9	7.3	5.5	0.55
Profit per boat	2	3	3	2.75	2.4	1.92	1.51	1.12	0.81	0.55	0.05

Given the technology described in the table, the game has a unique Nash equilibrium (2,2,3,3) in which two fishermen put out two boats each while the other two put out three boats. Consider a fisherman with two boats. Given that the three other fishermen operate eight boats in total, he earns a net income of 0.55 on each of his boats, yielding a total income of 1.10. Putting one more boat would reduce the average income per boat from 0.55 to 0.05, so that his total income would fall to 0.15. On the other hand, if he puts only one boat, he would get an income of 0.81. He therefore decides to put out two boats, which bring him more income than any other alternative. The same reasoning can be made for the three other fishermen, and the conclusion is reached that no one has any incentive to change his number of boats. As a result, (2,2,3,3) is a Nash equilibrium. (It can also be shown that it is a unique equilibrium.)

The total number of boats thus operated in the fishery (10) is clearly in excess to the social optimum which requires that only five boats be used to maximize aggregate profits. The problem is that no one, individually, has any incentive to deviate from his Nash equilibrium strategy. This tendency to overexploit common property resources characterizes what is known, since Hardin (1968), as the Tragedy of the Commons. It is important in so far as it applies to numerous and well-documented real-world situations in which common property resources have been manifestly depleted. The inescapable logic of the argument has been used to explain such varied situations as overgrazing in many semi-arid regions in the Third World, deforestation in some tropical countries, the depletion of many marine fisheries in developed and, increasingly, in developing countries, etc.[3]

Let us now introduce inequality among the different fishermen. For instance, consider an external constraint — say, a credit constraint — that has the effect of limiting the number of boats which some fishermen can own. The question is whether such a constraint is susceptible of reducing the extent of overexploitation of the fishery by altering the distribution of access rights.

Typically, rationing on the credit market deprives a number of operators of the funds necessary to acquire as many boats as they would like. In Table 2, the first column shows all the possible configurations of a constrained access by fishermen to boat ownership, under the assumption that the total credit available allows the financing of at most 10 boats. For example, (1,1,1,7) means that three fishermen can buy only one boat, while the last one can buy up to seven boats. The second column gives the respective values of the Gini coefficients pertaining to all possible distributions of

Table 2. *Impact of heterogeneity on the total amount and the distribution of appropriation efforts when increased efforts are impossible*

Distribution of credit constraints	Gini index of the distribution of credit constraints	Equilibrium allocation of boats	Index of efficiency in the final allocation (%)	Income of the poorest fisherman
1 1 1 7	0.45	1 1 1 4	88.0	1.51
1 1 2 6	0.40	1 2 3 3	88.0	1.51
1 1 3 5	0.35	1 1 3 3	75.0	1.12
1 1 4 4	0.30	1 1 3 3	75.0	1.12
1 2 2 5	0.30	1 2 2 3	75.0	0.81
1 2 3 4	0.25	1 2 3 3	58.0	0.85
2 2 2 4	0.15	2 2 2 3	58.0	1.10
2 2 3 3	0.10	2 2 3 3	45.0	1.10

the credit constraints. The resulting Nash equilibria of the instantaneous game where, given his credit constraint, each fisherman has to choose the number of boats to operate are described in the third column. These equilibria are computed in the same way as indicated with respect to Table 1. What is shown in the last column is an efficiency index of the Nash equilibria: it is calculated as the ratio of the total net income obtained in the final situations to the (first-best) optimum.

The striking feature that emerges from Table 2 is the following: given the users' inability to reach a binding agreement together, the most desirable situations obtain when the distributions of credit constraints are the most skewed. In these cases, indeed, the value of the efficiency index works out to 88%, which means that maximum inequality leads to an outcome that is remarkably close to the social optimum. This represents a significant improvement since the value of this index in the unconstrained Nash equilibrium (2,2,3,3) is as low as 45%. Furthermore, a comparison of the second and fourth columns reveals that there is a perfect rank correlation between the measure of efficiency in the equilibrium situations and the skewness of the distribution of credit constraints (as measured by the Gini coefficient). This is due to the fact that users with larger credit endowments have a strong incentive to exercise self-restraint and to leave unused part of their credit capacity, as smaller users, bound by their credit constraints, cannot increase their rates of use.

Equally noticeable is the fact that the distribution of income that is obtained when inequality is maximum is a Rawls-improvement over the distribution of income in the most equitable situation or the unconstrained Nash equilibrium. As a matter of fact, the poorest fishermen earn a higher income in the most inequitable situation (1.51) than in the most equitable one (2×0.55) although they operate fewer boats. Rather paradoxically, constraints or factor market imperfections that limit the access of some users to capital or other critical inputs may thus allow inequitable distributions of endowments to increase the incomes of the most constrained users.

As hinted at in the introduction, there is actually a wide array of constraints that can yield the above effect. The administrative distribution of harvesting licences by a central authority provides an interesting application of our central argument. Indeed, if the state distributes the available licences in an unequal way among the operating fishermen, it would create a situation in which the bigger licence-holders have an incentive not to use all their licences, which can even lead to an improvement of the incomes of the small licence-holders.

(b) *Voluntary contributions and technological choice*

Inequality does not necessarily have an unambiguous impact on collective action. To see this, let us now consider a situation in which each fisherman has to choose between different technologies rather than between different amounts of effort within a given technology. Technological choice bears upon the future state of the resource and the users' payoffs therefore correspond to the present values of all (discounted) future incomes.

When assessing the impact of inequality on the success of collective action, two distinct effects are at work. On the one hand, as Olson has emphasized, the greater the share in the benefits of a collective action for any single member, the greater the propensity of this "large" member to bear the costs involved (Olson, 1965, pp. 33–34). As a consequence, it is not surprising that wealthier users, because they usually have more incentives to "cooperate", tend to contribute more to collective action. On the other hand, when inequality is large, "small" users internalize such a tiny share of the benefits that they are not prompted to participate in the collective effort. Increasing inequality thus enhances the incentive of the big users to voluntarily contribute and simultaneously encourages the small users to free ride on the former's contributions. Consequently, the net impact of inequality on collective action will hinge upon the respective strengths of these two opposite effects (see also Heckathorn, 1993).[4] An important lesson from the above discussion is the following: the fact that rich users are more inclined to contribute does not imply that increased inequality favors collective action.

In the example considered here, we assume that three fishermen have access to a fishing ground but their rights of access may differ owing to unequal endowments in boats. First, consider a situation where one "big" fisherman has four boats while two "small" fishermen have only one boat each: this distribution of endowments is denoted as (4,1,1). Before

putting their boat(s) out at sea, these fishermen have to make a decision about the size of their net meshes to be operated from their boats: they may use nets with either small or large meshes (choice is binary). The use of small meshes is ecologically destructive (its generalized use causes future fish catches to decline abruptly), yet refraining from employing them is rewarding for an individual only if a sufficient number of gears use small meshes. To keep the discussion simple, we abstract here from time considerations and directly discuss the discounted sum of all future income flows minus the costs on the relevant time horizon as the "net income" per boat. Net incomes per boat vary depending upon the number of boats operating small-meshed nets, as indicated in Table 3.

For instance, it can be seen that when three boats use small meshes and the three other boats use large meshes, each of the former will get a net income of seven, while each of the latter will get only three. By convention, this payoff structure is written $P(3,3) = (7,3)$. Let us now start with the situation in which all six boats use small meshes and earn 4.5 units of income each. If one of the fishermen owning only one boat decides alone to shift to large meshes, his income falls from 4.5 to one unit. He therefore has no incentive to change. In contrast, by equipping his four boats with large meshes, the big fisherman actually increases his total income from 18 to 20 units. He therefore chooses large meshes. The situation in which every fisherman uses small meshes is not a Nash equilibrium. Knowing that the big fisherman always uses large meshes, each small fisherman also opts for large meshes. In other words, in this game there is only one Nash equilibrium where all the six boats operate the large-meshed nets. This favorable result follows from the fact that the big fisherman has a large enough endowment to allow internalization of a sufficient fraction of the externalities. He is consequently induced to adopt the resource conserving technique irrespective of the choice made by the other fishermen.

Consider now a more egalitarian distribution of boats, say (2,2,2). Two Nash equilibria can then be shown to exist, one in which every boat uses small-meshed nets (an inferior outcome) and the other in which all boats use large-meshed nets (the Pareto-dominating equilibrium). In this game, typically, fishermen face a coordination problem. If they all use small meshes, no one has an interest to shift to large meshes alone but, if he could be assured that the others would follow suit, he would make that choice (hence, the name "assurance game" given to this game).

In the above example, inequality is beneficial in so far as it leads to a unique equilibrium in which everyone "cooperates" by using nets with large meshes whereas with an equal distribution, the Pareto-dominating equilibrium is only a possibility. One may easily conceive of other situations where equilibrium configurations are different, yet the equilibrium under the more unequal distribution remains more efficient. For instance, inequality may yield a partial cooperation outcome while the more equal distribution leads to a Tragedy of the Commons. This situation obtains in Table 4 in which some of the payoffs ($P(1,5)$ and $P(2,4)$) of Table 3 have been changed.

In this new situation, with an equal distribution of assets, (2,2,2), there is a unique equilibrium and it corresponds to the Tragedy of the Commons: the dominant strategy for every fisherman is to use small meshes. By contrast, when the distribution is (4,1,1), the big fisherman is prompted to use large meshes on all his nets, whatever the choice made by the others. The latter continue to use small meshes and free-ride on the big fisherman's efforts.

From the foregoing account, it should not be inferred that inequality necessarily promotes collective action. It is easy to construct examples in which the equilibrium outcome is unaffected by the distribution of assets: this happens, for instance, if $P(1,5) = (13, 6)$ and $P(2,4) = (12,4)$. More generally, the relationship between inequality and efficiency in resource use is not monotonic. To see this, let us keep the payoff structure of Table 4 but modify the asset distribution from (4,1,1) to (3,2,1). As before, the small fisherman clings to small

Table 3. *Returns per boat in a fishery with two fishing techniques (case I)*

# boats using small meshes	0	1	2	3	4	5	6
# boats using large meshes	6	5	4	3	2	1	0
Average income per boat using small meshes	–	10	9	7	6	5	4.5
Average income per boat using large meshes	11	10	5	3	2	1	–

Table 4. *Returns per boat in a fishery with two fishing techniques (case II)*

# boats using small meshes	0	1	2	3	4	5	6
# boats using large meshes	6	5	4	3	2	1	0
Average income per boat using small meshes	–	13	12	7	6	5	4.5
Average income per boat using large meshes	11	10	5	3	2	1	–

meshes, yet, what the other two fishermen will do cannot be predicted with certainty. Indeed, they face an assurance game characterized by two equilibria, one in which both fishermen use small meshes, and the other in which they use large meshes. When they use large meshes, the outcome is more efficient than that obtaining under the more unequal distribution (4,1,1), since there is now only one free-rider. It is striking that the former outcome even Pareto-dominates the latter.

Resource use efficiency can thus be greater with the more equal distribution. This result actually arises from the fact that one of the small fishermen, following the enlargement of his asset base, has now become able to internalize sufficiently the benefits of his self-restraint as to be induced to use large meshes, provided that the biggest user does likewise. This points up the importance of the role played by the small agents that we have underlined in the beginning of this section. In the same logic, it may be shown that situations exist in which inequality just destroys the possibility of an efficient equilibrium. This happens if the structure of the payoffs is as follows (see Table 5):

Under the (2,2,2) distribution of entitlements, the users face a coordination game, and there are two equilibria (in pure strategies): in the first equilibrium, all agents use small meshes, and in the second one, they all use large meshes. Under the (4,1,1) distribution, there is a unique Nash equilibrium in which all agents use the destructive technology. The same holds true under the (3,2,1) distribution.

At this juncture, it is evident that two parameters play a pivotal role in the determination of equilibrium strategies, namely the biggest and the smallest endowments held by an individual user. To understand why this is so, it is useful to consider the situation in which no cooperation occurs. Such a situation is a Nash equilibrium if and only if the largest endowment is not so big that its owner wants to modify his choice. This is clearly the problem raised by Olson in his *Logic of Collective Action* (1965). As for the other extreme situation in which everybody, whether big or small, cooperates, it will be a Nash equilibrium if and only if the smallest endowment is still large enough to create an incentive for its owner to cooperate.

Even assuming that small agents have too little incentive to cooperate, it is not certain that generalized free-riding will occur since the big users may still have an interest in cooperating among themselves. Such situations of partial cooperation will correspond to Nash equilibria only if among the cooperating users, the agent with the smallest endowment has no incentive to stop cooperating, and among the noncooperating users, the agent with the biggest endowment has no incentive to join the cooperators.

To sum up, there is nothing like a one-to-one relationship between inequality and collective action and, therefore, Olson's argument cannot be used in favor of inequality in applications pertaining to management of common property resources. If it is true that, in general, better endowed members tend to contribute more, it does not follow that inequality itself promotes collective action. In actual fact, as the above examples demonstrate, its impact is highly sensitive to the characteristics of the technology. In particular, if the participation of all users is required to sustain the efficient outcome (think of a Leontief technology as involved in the use of dynamite or cyanide in coral reef

Table 5. *Returns per boat in a fishery with two fishing techniques (case III)*

# boats using small meshes	0	1	2	3	4	5	6
# boats using large meshes	6	5	4	3	2	1	0
Average income per boat using small meshes	–	13	9	7	6	5	4.5
Average income per boat using large meshes	11	6	4	3	2	1	–

fishing), inequality can only make this outcome more difficult to attain. On the contrary, if the efficient outcome requires only a small number of cooperating units, inequality is more likely to yield cooperation than equality.[5]

There is ample evidence supporting the view that richer users who have a larger interest in a collective good tend to devote more resources to its production. This is the result obtained by (Gaspart *et al.*, 1998) in their analysis of a watershed management scheme in the Ethiopian Highlands. Analyzing the determinants of the number of work-hours spent on the building of a common infrastructure, they indeed find that

> individual labor contributions to the public good are well explained by factors which clearly determine the potential interest individuals can have in it. In other words, participation rates are largely influenced by the potential benefits which different community members can expect to draw from the creation of a drainage infrastructure (Gaspart *et al.*, 1998, p. 21).

A similar conclusion can be derived from a study by White and Runge (1995) on collective action in watershed management in Haiti. In this case, indeed, potential gains from the building of a soil conservation infrastructure, and awareness of these gains, appear to be a major determinant of participation rates.

The discussion above also applies to situations in which users have the same right of access to the resource, say the same number of boats, yet they discount future incomes differently because of varying wealth endowments. If, as argued in Section 2, richer users are less impatient, the discounted value of their future benefits tends to be higher than that of poorer users. The payoff they obtain from adopting a resource conserving strategy is therefore higher. Once again, growing inequality in wealth, leading to increasingly divergent payoffs, has an ambiguous impact on collective action depending on the characteristics of the technology. For instance, as reported by (Van Den Breemer *et al.*, 1995), in Northern and Western Senegal, immediate safeguarding of the food supply has become the first priority of ordinary peasants because of the low fertility of the land, insufficient rainfall and incidental swarm of locusts. Long-term investments in soil or trees are not undertaken because they would in fact endanger the food supply.

> For many people forest exploitation is, directly or indirectly, an effective means to alleviate their economic problems: it yields money immediately, which is certainly not true of investments in forests and trees (Van Den Breemer *et al.*, 1995, pp. 102–103).

4. COLLECTIVE ACTION WITH SOCIAL REGULATION

(a) *Wealth inequality and the formation of a regulatory authority*

In the foregoing discussion, agents have been assumed to interact in a completely decentralized manner. In numerous situations observed in the field, however, there often exists a local authority charged with laying down and enforcing rules for the use of the CPRs (for more details, see Baland and Platteau, 1996, chapter 12). The question then immediately arises as to how the cost of collective regulation, that is, the cost of initiating and performing regulatory task, is borne within the group of users.

The logic of the argument here is the same as that underlying our discussion of the impact of inequality on technological choice. Indeed, in most instances, the creation of a regulatory authority can be interpreted as a public good for which costs have to be incurred. These costs partly consist of the time and other resources devoted to collectively organize regulation and to ensure its proper implementation (monitoring and sanctioning activities, dispute settlements, rule revision, etc.). Moreover, the initial effort required to mobilize the users concerned and to reach a mutually satisfactory agreement makes up an important part of the fixed costs of initiating collective action.

Benefits from such action can be thought of as increasing with intensity of use of the resource, which is itself related to wealth endowment. Therefore, the incentives to bear the above costs can be considered as rising with wealth. Inequality may thus play a useful role by giving the better-endowed members sufficient incentives to incur the costs involved (see also Bardhan, 1993, p. 638; Bardhan *et al.*, 1998).

There is abundant evidence to support the hypothesis that the costs of initiating collective action are largely borne by the economic elite. Thus, rural cooperatives in the Netherlands were often created by groups

> of influential, better-off farmers who took the initiative to start a services or credit coop and to contribute the bulk of initial share capital. Smaller producers would join at a later stage, contributing smaller shares

(Braverman *et al.*, 1991, p. 6), contradicting the idea that homogeneity between members is a necessary condition for the success of such cooperatives. In the same vein, in his in-depth study of irrigation systems in South-Indian villages, Wade cogently argues that the effectiveness of a local irrigation council "depends on its councillors all having a substantial private interest in seeing that it works, and that interest is greater a larger a person's landholding" (Wade, 1987, p. 230). The claims that big landowners can make "are sufficiently large for some of them to be motivated to pay a major share of the organisational costs" (Wade, 1988, p. 190).

Likewise, in the Pithuwa irrigation system in Nepal, it so happens that many of the large landowners have their lands located near the tail of the system (which is also near to the east-west highway and thus entails low-cost transportation of produce to markets). Even though the area was not organized prior to canal construction, thanks to the initiative of some prominent farmers, the whole irrigation project became self-managed through evolution from organization on one branch at the tail of the system to the organization of the entire system (Laitos, 1986, pp. 126–127 — cited in Ostrom and Gardner, 1993, p. 105). In Ha Nchele, a lowland village in Lesotho, rotational grazing has been successfully introduced on village grazing lands as an alternative to taking animals to a cattle post in the mountains, mainly because the village chief held the greatest number of livestock, and thereby took a predominant part in the development of the project (Swallow and Bromley, 1995). In rural Mexico, we are told of the important role played by the Indian *caciques* (rich Indians acting as patrons) who use to mobilize labor and assume leadership for the management of common lands, including important conservation measures such as steep-slope management and erosion control (Garcia-Barrios and Garcia-Barrios, 1990). To take a last example, in Imperial China, the representatives of dominant lineages had a great deal of influence in the selection of the forest manager and in the setting and enforcement of the rules regulating the access to and the use of the local forests and wildlands. Those dominant lineages controlled a large portion of the land and the benefits it yielded (Menzies, 1994, pp. 80–85).

The involvement of large users may even take on the form of "excess" contributions to the regulatory scheme for fear that it would collapse. An example of this possibility in the field of industrial economics is the attitude of Saudi Arabia which for many years subsidized OPEC by producing less than its quota of oil to compensate for excess production by other members of the cartel (Heckathorn, 1993, p. 329). In the Kgatleng (Botswana), the rule is that all co-owners of a borehole pay an equal share of the monetary costs of construction, repair and maintenance irrespective of the size of their herd. In practice, however, wealthy herd owners tend to contribute spontaneously more than the poorer members of the borehole syndicate when it comes to in-kind contributions. This is in conformity with the spirit of *ipelegeng* which prescribes "helping out in whatever way one can as a member of a group" (Peters, 1994, p. 121).

As has been stressed in the above section, however, the fact that better endowed agents tend to be more involved in the collective action process does not imply that increased wealth inequality necessarily increases the chances of development of regulatory mechanisms. It indeed narrowly depends on the political or social "technology" of collective action. For example, if the active support of all users is socially needed, reduced incentives for the smaller users to participate may undermine regulation. Conversely, if the starting of regulation requires the personal commitment of a single individual user (or of a few of them), it is crucial for the success of collective action that this (these) user(s) can internalize a sufficiently large share of the expected benefits.

There are numerous examples showing how inequality weakens the prospect of collective action when some users are so small or attach so little weight to their resource endowment that they have no real stake in participating in it. Thus, many young people from villages in Botswana work as temporary migrants in South Africa. When they return home (for short periods of time), they do not attend any more the village public forum meetings where issues of common concern including problems of CPR management are debated and settled. The original access rights to village CPRs which they still retain have indeed lost so much of their value that they are not any more induced to participate in collective decision-making (Zufferey, 1986).

Of course, as attested by the following story, wealthier users can also have reduced incentives to participate in collective action, as their wealth endowment affords them attractive outside opportunities. In the arid areas of Western Rajasthan, before the modern state was formed by conglomerating the princely

states of Rajputana, communal grazing lands used to be under the effective control of big landlords known as *jagirdars*. By virtue of their dominating position, they could appropriate a large share of the benefits accruing from the exploitation of the common property resources (the best pastures were indeed earmarked for the animals owned by them). It is therefore not surprising that they took upon themselves the task of deciding and implementing "conservation measures which ensured considerable stability to these resources" (Shanmugaratnam, 1996, p. 172). Thus they charged grazing taxes, organized rotational grazing around (evenly scattered) water-points, decreed the periodical closure of parts of the commons and periodical restrictions on entry of certain animal species, appointed watchmen to monitor compliance with the grazing regulations, imposed penalties on herd owners found guilty of violating them, and used their authority to extract regular labor contributions for maintenance works from poorer users. Such measures had the effect of conserving perennial grass species and trees and of allowing effective rotational grazing thanks to proper maintenance of water points (Jodha, 1987, 1989).

After independence, following a land reform that resulted in the privatization of a large part of the village grazing areas and in the dissolution of the *jagirdari* rule and its replacement by the *panchayat* system, collective maintenance of the commons was discontinued. Degradation followed as evidenced by poor growth of grass, spread of sand dunes and death of trees. The problem is that in the new circumstances the biggest landowners are able to produce a large part of their fodder needs on their private land (crop residues are privatised since farms are opened after harvest only after the owner's livestock has grazed the bulk of the crop residues) and have the wherewithal to buy from the market the supplementary feed needed. Given their high degree of self-sufficiency in fodder, they tend to be uninterested in the management of the remaining common. In contrast, poorer farm owners are highly dependent on these commons for access to fodder yet prove unable to coordinate their actions so as to prevent resource degradation, due partly to a lack of effective institutional mechanism suited for that purpose and partly to a great concern with immediate survival needs (Gupta, 1986, p. 312; Shanmugaratnam, 1996, pp. 173–178). Regarding the former factor, it is noteworthy that the *panchayat* has not proved useful as it is rooted in increasingly sharp caste antagonisms and its style is excessively formal and top-down. On the other hand, no leadership had emerged from the mass of poorer farm owners presumably because each of them internalizes too small a share of the benefits resulting from well-managed village pastures to be incited to bear the cost of initiating collective action.

Wealthier users can not only refrain from participating in resource-preserving collective actions, but they may also attempt to undermine such actions in order to further their own private interests. In Mali, for example, the emergence of absentee herd owners with outside economic opportunities appears to be a major stumbling block on the way toward pastoral institution-building for sustainable rangeland management. This was a result of the great Sahelian droughts in the 1970s when pastoralists were forced to sell their livestock to farmers or, more generally, to wealthier town-dwellers such as traders and civil servants. According to a recent evaluation study of the Mopti Area Development Project,

> Absentee herd owners favour open access rangelands so that their herds can graze anywhere. They may even use their political influence to prevent pastoral associations receiving legally defensible land rights (Shanmugaratnam *et al.*, 1992, p. 20).

(b) *Regulation through transfers, quotas and taxes*

From economic theory, we know that when information is perfect and the central agency is able to enforce interagent transfers, individual taxes or quotas, the Pareto-optimal situation can be attained, and this result holds irrespective of the degree of inequality among the participants. Things are, however, more complex when the assumption of perfect information is dropped since users may then have an incentive to lie about their real endowments or their true use of the resource. This is worrying since knowledge about these is crucial for a central authority to devise a regulatory scheme such that every user is better off at the efficient situation (see, e.g., Roemer, 1988).

This knowledge is especially useful in the presence of inequality since users are then more likely to differ in nonobservable characteristics which directly affect their use of the CPR (such as fishing or hunting skills, the value presently attached to the CPR, or the extent of access to outside income opportunities). In the absence

of such critical information about users' characteristics, communities tend to have recourse to systems of uniform treatment of all users, irrespective of their type.

Another powerful motive against unequal treatment of different users rests upon the traditional ethics of village communities. Typically, indeed, access to communal resources is mediated through membership in a social group. The relation is reciprocal: on the one hand, group membership is the basis of social rights, and, on the other hand, maintaining access to a share of the corporate productive assets serves to validate membership in the group. In these conditions, an unequal treatment of users would be considered to introduce or reflect a hierarchy of social status. In the same logic, communities tend to avoid monetary payments to a fraction of their members as such payments will be viewed by the people concerned as a manoeuvre aimed at buying their exclusion from customary entitlements (Berry, 1984; Bourdieu, 1977, 1980).

The literature dealing with CPR management in village societies actually abounds with examples of uniform quotas and taxes, or transfer payments destined for equalizing individual incomes. As illustrated by the case of Japan, uniform quotas can be observed in rural communities characterized by strong economic differentiation. According to McKean (1986), indeed, in preindustrial Japanese villages, a relatively egalitarian treatment of all villagers with respect to use of local CPRs went hand in hand with inequality in private landholdings and political power.[6] As she aptly put it:

> Japanese villagers were deeply concerned with some notion of fairness. (...) Fairness was not synonymous with equality in material possessions. (...) But there was an overriding sense that access to the commons should be distributed according to some principle of fairness that ignored existing maldistributions in private wealth. Hence the frequent use of random distributions, assignment to parcels or products of the commons by lottery, frequent rotations to move the good and the bad around, and scrupulous attention to bookkeeping to keep track of contributions and exchanges and offsetting aid offered by one household to another. (...) Nor did this notion of fairness mean that entitlement was automatic for all comers; (...) a household had to earn its eligibility through some period of established residence in the village, and casual drifters were ignored (McKean, 1986, pp. 568–569).

The adoption of these measures actually occurred during the 17th century as a response to increased environmental pressure on common lands which caused serious degradation of village forests:

> visible deforestation seems to have made villagers aware of the very real risks of overuse and enabled them to develop and enforce stricter rules for conservation on their own initiative to save their forests and commons from the same fate. Rather than destroying the commons, deforestation resulted in increased institutionalization of village rights to common land. And it promoted the development of literally thousands of highly codified sets of regulation for the conservation of forests and use of all commons (McKean, 1986, p. 549 — for similar systems in India and Nepal, see Guha, 1985, p. 1940; Arnold and Campbell, 1986, p. 436).[7]

When uniform quotas are used in strongly inegalitarian agrarian societies, the economic elite typically behave as patrons toward poor people. Equal treatment of the poor is then part of an informal insurance mechanism whereby rich people socially protect their clients in return for benefits in other sectors of social life. The logic of patron–client relationships leads the rich to even tolerate rule violations by the poor when under exceptional circumstances uniform quotas are not sufficient to guarantee the latter's subsistence. For example, in his study of South-Indian villages, Wade has observed that, when crisis conditions created by drought cause desperation among the poor, they follow

> short-term strategies which they would not contemplate in normal times and, with the implicit consent of wealthier villagers, they break the rules laid down for effective management of water in irrigation schemes (Wade, 1988, p. 204).[8]

In numerous cases, uniform treatment of resource users at local level takes on the form of rotation schemes for access to the CPR. It is noteworthy that in many such schemes, those temporarily deprived of access to the resource are entitled to receive material compensations from the other users so as to be able to sustain themselves on a continuous basis. A vivid illustration of this principle has been observed in the floodplain inland fisheries along the Logone river in Chad (Drijver *et al.*, 1995). Within the boundary of a village called Ere, the river is divided into sections which are allocated to the different quarters forming the local community. Following a more or less fixed sequence, each year the so-called river chiefs (who are in charge of controlling the use of given sections)

together with the village chief nominate one village quarter to refrain from all fishing activities in its river section. The important point is that migrating fish species coming from Lake Chad as well as species that have survived in the river itself reach high density levels in the protected section. Early spawning, initiated by locally made boxes placed in the shallow parts, thus provides a source of fingerlings which can reach the depressions, marshes and plains once the flood starts.

> When the densities of both the migratory and residential fish species reach a high level (monitored by the village chief through try-out sampling) the village chief and river chiefs allow all villagers to embark on communal fishing in the protected river sections. The villagers are obliged to deliver 10 percent of the catches to the village chief and the river chief whose section was nominated to be the protected section that particular year (Drijver *et al*., 1995, p. 32).

The latter redistributes this transfer amount to the members of his village quarter in order to compensate them for the loss of fish catches during the period of illegal fishing (a period which can extend up to the end of the dry season).

Another illustration of the role of transfers as a means of equalizing incomes for all users of a village CPR is given by Lopez (1984) in his study of fisheries in the Batanes Islands (Philippines): there, the number of boats that go out fishing is determined on the basis of a scout's report of the day's potential catch but the catch is divided equally among all households regardless of the number of boats operated (see also Alexander, 1982; Agrawal, 1994).

At a more general level, evidence from Africa suggests that, when a resource improvement project is implanted in a village, there is a frequent tendency among local inhabitants to exercise pressure so that the project can benefit everyone of them. This often leads to tensions between rural development organizations which are keen on completing existing projects (as efficiency would recommend) on the one hand, and, on the other hand, the villagers who are anxious that the benefits are evenly spread among all of them and therefore frequently ask that new projects are being started in other parts of the village before the first are completed (see, for instance, Laurent and Mathieu, 1995, p. 91). This kind of experiences attest to the eagerness of villagers to receive compensations when they are excluded from the benefits of a localized public good.

Unfortunately, when uniform quotas or taxes are applied in the presence of inequality, the commons are likely to be inefficiently regulated. In a companion paper, we have indeed shown that with uniform quotas (or taxes) the more heterogeneous the user group, the more distant the regulated outcome from the Pareto-optimal solution (Baland and Platteau, 1998; see also Kanbur, 1992). In addition, the more inequality among users the more the regulated solution (without transfer) will hurt a fraction of them. Relatedly, if we require that the regulated outcome Pareto-dominates the unregulated outcome (that is, if we require that no user is worse off in the post-regulation situation while at least one of them is better off), a greater measure of inefficiency in the use of the CPR will result from a higher degree of inequality.

These results shed light on Johnson and Libecap's analysis of the failure of cooperative mechanisms for catch restriction in the overcapitalized shrimp fishery of Texas. In their own words:

> Contracting costs are high among heterogeneous fishermen, who vary principally with regard to fishing skill. The differential yields that result from heterogeneity affect the willingness to organize with others for specific regulations ... regulations that pose disproportionate constraints on certain classes of fishermen will be opposed by those adversely affected. (...) Indeed, if fishermen had equal abilities and yields, the net gains from effort controls would be evenly spread, and given the large estimates of rent dissipation in many fisheries, rules governing effort or catch would be quickly adopted. (...) For example, total effort could be restricted through uniform quotas for eligible fishermen. But if fishermen are heterogeneous, uniform quotas will be costly to assign and enforce because of opposition from more productive fishermen. Without side payments (which are difficult to administer), uniform quotas leave more productive fishermen worse off (Johnson and Libecap, 1982, pp. 1006, 1010).

An important implication of the above considerations is the following: to the extent that village societies mete out equal treatment to all their members regarding use of local CPRs and that interest in these resources (as determined by individual wealth endowments)[9] is not equally distributed among them, the regulated outcome may be expected to be socially inefficient. This point bears all the more emphasis as there is a clear, albeit often implicit, tendency in the empirical literature to equate effective regulation with efficiency, that is, to infer from the observed existence of vil-

lage-level regulatory mechanisms that efficient use of local resources is thereby ensured. If inequality is too high, even effectively enforced mechanisms for CPR management can not be very efficient.

A final remark is in order. In unequal agrarian societies, weaker categories of users are frequently excluded by dominant groups to achieve more efficient use of the CPRs (see, e.g., Allen, 1992; Cohen and Weitzman, 1975; Peters, 1994; Laurent and Mathieu, 1995, pp. 194–195; André and Platteau, 1997). In the absence of transfers, this solution involves considerable costs in terms of distributive justice. We will not deal here with such exclusionary processes, however, since they cannot be viewed as a consequence of inequality as such.

5. CONCLUSION

There is a tendency nowadays in the literature to represent issues of collective action as though agents were acting in a completely decentralized way. This research program is obviously influenced by the rapid development of noncooperative game theory as a powerful tool to analyze strategic human interactions. Now, there is an apparent discrepancy between this approach and one of the main conclusions which emerge from the large body of empirical literature dealing with local-level management of common property resources. This literature is indeed replete with examples where natural resources at village level are managed on the basis of rules designed and enforced by a regulatory agency.

Without denying the importance of distinguishing between the two kinds of situations (as has been actually done in this paper), it must be reckoned that even when dealing with regulated settings, at some point in the analysis, one cannot evade the question as to how agents acting in a noncoordinated way initiate and enforce the regulation scheme. It is thus not surprising that the basic argument underlying our whole discussion about the potential of collective action in a decentralized setting also applies when the creation of regulatory mechanisms is considered. Indeed, according to this argument, the distribution of incentives among agents plays a crucial role. As a matter of fact, a disequalizing change in the distribution of access rights has two effects which run in opposite directions. The agents who benefit from such a change have a larger stake in the common property resource and therefore have a greater incentive to take conservation measures. Simultaneously, the same change has a corresponding disincentive effect on the other agents whose endowments have been reduced. Increasing inequality, because it redistributes incentives in different directions, thus has ambiguous effect on the ability of users to take steps toward conserving their resources and even toward setting up the required mechanisms.

This said, once a regulatory agency is set up, inequality among resource users tends to make the functioning of regulation proper more difficult, whether it involves transfers, quotas or taxes. As a matter of fact, the efficiency achieved by regulation decreases with growing inequality, all the more so if the regulated outcome is to be acceptable to all users.

NOTES

1. Note that privileged access to a CPR does not necessarily take on the form of a comparatively large number of harvesting units put into use (boats to catch fish in a water space, laborers to collect fuelwood in the forest, animals to graze on the pasture, land parcels in an irrigated scheme, ...) but may also manifest itself in the ability of some users to occupy strategic positions in the CPR (e.g., privileged access to good fishing sites, proximity to wells in grazelands) which secure them a large share of the benefits.

2. Case studies by Rosensweig and Binswanger (1993) and Rosensweig and Wolpin (1993) suggest that investment behavior tends to be distorted by subsistence constraints among poor farmers (see also the survey by Bardhan *et al*., 1998).

3. Note indeed that in our examples the number of users is fixed, which implies that there is some sort of regulation in the communities concerned. Genuine situations of open access will not be considered in this paper, since they do not refer to a well-defined group and, therefore, do not allow for strategic interactions among users.

4. According to the so-called neutrality theorem, the private provision of a pure public good is unaffected by a redistribution of wealth. The relevance of the conditions

that are attached to this striking result is however to be doubted in the case of CPR management, basically because (a) CPR are not a pure public good, and (b) the theorem does not apply when some (non-) contributors (start) stop contributing. (For more details on this point, see Baland and Platteau, 1997).

5. Finally, it is worth emphasizing that there is no such case where inequality destroys collective action while equality necessarily leads to the efficient outcome as a Nash equilibrium. Indeed, as long as per unit benefits increase with the number of cooperating units, starting from the inefficient situation a small user has always fewer incentives to cooperate than a larger user. Therefore, if the inefficient situation is not a possible Nash equilibrium under an equal distribution, it cannot be one under a more unequal distribution. Thus, the worst case against inequality obtains when equal distribution yields an assurance game while inequality leads to the PD game.

6. It is a noteworthy aspect of the Japanese regulation system that equal quotas are allotted on a household basis so as to avoid giving advantages to large families and thus discourage population growth. To make this system effective, the formation of any new household is subject to approval by the community (McKean, 1986).

7. We can find similar examples in contemporary Europe. Thus, management of common woodlands in southern Belgium often implies a strictly egalitarian access, each family being entitled to a specified amount of fuelwood per year, a right locally known as 'affouage'. The trees to be cut are designated by the communal authority.

8. The same flexibility in the application of uniform quotas when special conditions arise characterizes many agrarian societies even outside the purview of patronage relationships. Thus, in the above-quoted study, McKean notes that, under stress conditions, tolerance is shown *vis-à-vis* poor resource users and "inspectors or other witnesses who saw violations maintained silence out of sympathy for the violators' desperation" (McKean, 1986, p. 566).

9. Bear in mind that there needs not be a simple relationship between distribution of wealth and distribution of interests in the CPRs. Thus, rich members may have a low stake in these resources if they have available to them alternative income opportunities. Therefore, equal access of the poor under the protection of rich users behaving as patrons is no sufficient evidence of inefficient CPR use.

REFERENCES

Agrawal, A. (1994) Rules, rule-making, and rule-breaking: Examining the fit between rule system and resource use. In *Rules, Games and Common-Pool Resources*, ed. E. Ostrom, R. Gardner, and J. Walker, pp. 267–282. The University of Michigan Press, Ann Arborm, MI.

Alexander, P. (1982) *Sri Lanka Fishermen — Rural Capitalism and Peasant Society*. Australian State University, Canberra.

Allen, R. (1992) *Enclosures and the Yeomen*. Oxford University Press, Oxford.

André, C. and Platteau, J. P. (1997) Land relations under unbearable stress: Rwanda caught in the Malthusian trap. *Journal of Economic Behavior and Organization* **34**(3), 1–47.

Arnold, J. E. M. and Campbell, J. G. (1986) Collective management of hill forests in Nepal: The community forestry development project. In *Proceedings of the Conference on Common Property Resource Management*, ed. National Research Council, pp. 425–454. National Academic Press, Washington, DC.

Baland, J.-M. and Platteau, J.-P. (1996) *Halting Degradation of Natural Resources. Is there a Role for Rural Communities?* Clarendon Press, Oxford.

Baland, J. M. and Platteau, J. P. (1997) Wealth inequality and efficiency in the commons — Part I: The unregulated case. *Oxford Economic Papers* **49**(4), 451–482.

Baland, J. M. and Platteau, J. P. (1998) Wealth inequality and efficiency in the commons — Part II: The regulated case. *Oxford Economic Papers* **50**(1), 1–22.

Bardhan, P. (1993) Analytics of the institutions of informal cooperation in rural development. *World Development* **21**(4), 633–639.

Bardhan, P., Bowles, S. and Gintis, H. (1998) Wealth inequality, wealth constraints and economic performance. In *Handbook on Income Distribution*, ed. A. Atkinson, and F. Bourguignon, North-Holland, Amsterdam.

Berry, S. (1984) The food crisis and agrarian change in Africa: A review essay, *African Studies Review* **27**, 59–112.

Bourdieu, P. (1977) *Algérie 1960*. Editions de Minuit, Paris.

Bourdieu, P. (1980) *Le Sens Pratique*. Editions de Minuit, Paris.

Braverman, A., Guasch, J. L. Huppi, M. and Pohlmeier, L. (1991) Promoting rural cooperatives in developing countries — The case of Sub-Saharan Africa. World Bank Discussion Papers, No. 121, The World Bank, Washington, DC.

Coate, S. and Ravaillon, M. (1993) Reciprocity without commitment: Characterization and performance of informal insurance arrangements. *Journal of Development Economics* **40**(1), 1–24.

Cohen, J., and Weitzman, M. (1975) A Marxian view of enclosures. *Journal of Development Economics* **1**(4), 287–336.

Drijver, C. A., VanWetten, J. C. J. and De Groot, W. T. (1995) Working with nature: Local fishery management on the Logone floodplain in Chad and Cameroon. In *Local Resource Managemetnt in Africa*, ed. H. P. M. Van den Breemer, C. A. Drijver, and L. B., Venema, pp. 29–45. John Wiley and Sons, New York.

Fafchamps, M. (1992) Solidarity networks in preindustrial societies: Rational peasants with a moral economy. *Economic Development and Cultural Change* **41**(1), 147–174.

Garcia-Barrios, R. and Garcia-Barrios, L. (1990) Environmental and technological degradation in peasant agriculture: A consequence of development in Mexico. *World Development* **18**(11), 1569–1585.

Gaspart, F., Jabbar, M., Melard, C. and Platteau, J. P. (1998) Participation in the construction of a local public good with indivisibilities: An application to watershed development in Ethiopia. *Journal of African Economies* **7**(2), 157–84.

Guha, R. (1985) Scientific forestry and social change in Uttarakland. *Economic and Political Weekly* **20**, 1939–1952.

Gupta, A. K. (1986) Socioecology of stress —Why do common property resource management projects fail? In *Proceedings of the Conference on Common Property Resource Management*, ed. National Research Council. National Academy Press, Washington DC.

Hardin, G. (1968) The tragedy of the commons. *Science* **162**, 1243–1248.

Hardin, R. (1982) *Collective Action*. John Hopkins University Press, Baltimore.

Hayami, Y., and Kikuchi, M. (1981), *Asian Village Economy at the Crossroads — An Economic Approach to Institutional Change*. University of Tokyo Press, Tokyo.

Heckathorn, D. W. (1993) Collective action and group heterogeneity: Voluntary provision versus selective incentives. *American Sociological Review* **58**, 329–350.

Jodha, N. S. (1987) A case study of the degradation of common property resources in Rajasthan. In *Land Degradation and Society*, ed. P. Blaikie and P. Brookfield. Methuen, London and New York.

Jodha, N. S. (1989) Fuel and fodder management systems in the arid region of Western Rajasthan. International Centre for Integrated Mountain Development, Kathmandu, Nepal.

Johnson, R. N., and Libecap, G. D. (1982) Contracting problems and regulation: The case of the fishery. *American Economic Review* **72**, 1005–1022.

Kanbur, R. (1992) Heterogeneity, distribution, and cooperation in common property resource management. Policy Research Working Papers, The World Bank, Washington DC.

Kimball, M. S. (1988) Farmers' cooperatives as behavior towards risk. *American Economic Review* **78**(1), 224–232.

Laitos, R. (1986) Rapid appraisal of nepal irrigation systems. Water Management Synthesis Report No. 43, Colorado State University, Fort Collins, CO.

Laurent, P. J. and Mathieu, P. (1995) Action locales, enjeux fonciers et gestion de l'environnement au Sahel. *Cahiers du Cidep* **27**, Louvain-la-Neuve, Belgium.

Lopez, M. D. (1984) Notes on traditional fisheries in the Philippines. Marine Sciences Center, University of the Philippines, Quezon City.

McKean, M. A. (1986) Management of traditional common lands (Iriaichi) in Japan. In *Proceedings of the Conference on Common Property Resource Management*, ed. National Research Council, pp. 533–589. National Academy Press, Washington, DC.

Menzies, N. K. (1994) *Forest and Land Management in Imperial China*. St. Martin's Press, London.

Oliver, P. E. and Marwell, G. (1988) The paradox of group size and collective action: A theory of the critical mass. II. *American Sociological Review* **53**, 1–8.

Oliver, P. E., Marwell, G. and Tuxera, R. (1985) A theory of the critical mass. I. Interdependence, group heterogeneity and the production of collective action. *American Journal of Sociology* **91**, 522–556.

Olson, M. (1965) *The Logic of Collective Action*. Harvard University Press, Cambridge, MA.

Olson, M. (1982) *The Rise and Decline of Nations*. Yale University Press, New Haven, CT.

Ostrom, E. (1990) *Governing the Commons — The Evolution of Institutions for Collective Action*. Cambridge University Press, Cambridge.

Ostrom, E., and Gardner, R. (1993) Coping with asymmetries in the commons: Self-governing irrigation systems can work. *Journal of Economic Perspectives* **7**(4), 93–112.

Peters, P. E. (1994) *Dividing the Commons — Politics, Policy, and Culture in Botswana*. The University Press of Virginia, Charlottesville.

Platteau, J.-P. (1991) Traditional systems of social security and hunger insurance: Past achievements and modern challenges. In *Social Security in Developing Countries*, ed. E. Ahmad, J. Drèze, J. Hills, and A. K. Sen, pp. 112–170. Clarendon Press, Oxford.

Roemer, J. E. (1988) A public ownership resolution of the tragedy of the commons. Working Paper No. 295, Department of Economics, University of California, Davis, C4.

Rosensweig, M. and Binswanger, H. (1993) Wealth, weather risk and the composition and profitability of agricultural investment. *Economic Journal* **103**, 56–78.

Rosensweig, M. and Wolpin, K. (1993) Credit market constraints, consumption smoothing, and the accumulation of durable production assets in low-income countries: Investment in bullocks in India. *Journal of Political Economy* **101**(2), 223–244.

Sandler, T. (1992) *Collective Action: Theory and Applications*. University of Michigan Press, Ann Arbor, MI.

Sandler, T. and Forbes, J. F. (1980) Burden sharing, strategy and the design of NATO. *Economic Inquiry* **18**, 425–444.

Shanmugaratnam, N., Vedeld, T. Mossige, A. and Bovin, M. (1992) Resource management and pastoral institution building in the West African Sahel.

World Bank Discussion Papers, No. 175, The World Bank, Washington DC.

Shanmugaratnam, N. (1996) Nationalisation, privatisation and the dilemmas of common property management in Western Rajasthan. *Journal of Development Studies* **33**(2), 163–187.

Swallow, B. and Bromley, D. (1995) Institutions, governance and incentives in common property regimes for african rangelands. *Environmental and Resource Economics* **6**(1), 99–118.

Udry, C. (1994) Risk and insurance in a rural credit market: An empirical investigation in Northern Nigeria. *Review of Economic Studies* **61**, 495–526.

Van Den Breemer, H. P. M., Bergh, R. R. and Hesseling, G. (1995) Towards local management of natural resources in Senegal. In *Local Resource Management in Africa*, ed. H. P. M. Van Den Breemer, C. A. Drijver and L. B. Venema, pp. 97–110. John Wiley and Sons, New York.

Wade, R. (1987) The management of common property resources: Finding a cooperative solution. *The World Bank Research Observer*, **2**(2), 219–234.

Wade, R. (1988) *Village Republics — Economic Conditions for Collective Action in South India*. Cambridge University Press, Cambridge.

White, T. A. and Runge, C. F. (1995) The emergence and evolution of collective action: Lessons from watershed management in Haiti. *World Development* **23**(10), 1683–1698.

Zufferey, F. S. (1986) A study of local instituttions and resource management inquiry in Eastern Central District. Research Paper N° 88, Land Tenure Center, University of Wisconsin-Madison.