1. Property regimes (Based on Cohen and Weitzman 1974.)

Pescado is a small town with 5000 fishers. Because they have little education, the fishers of Pescado cannot do anything else than fish to make a living. Next to town, there are only two lakes where fishers can catch fish, lake Tilapia and lake Loyola (named after a Jesuit missionary who lived there in a time when fish scarcity was not an issue).

The aggregate output function of lake Tilapia is given by

$$y_T = 12x_T - 2x_T^2,$$

while that of lake Loyola is

$$y_L = 7x_L - \frac{1}{2}x_L^2,$$

where $x_T \times 10^3$ and $x_L \times 10^3$ denote the respective number of fishers on lakes Tilapia and Loyola, and y_i denote the total catch in thousand of pounds of fish. The price of one pound of fish is fixed and equal to 1.

(1) What will be the distribution of workers between the lakes in an regime of *open-access*? (Explain intuitively how you arrive at this distribution. By open-access, we wish to represent a situation equivalent to an arbitrarily large number of fishers.)
(2) What will be the distribution of fishers between the lakes in a regime of exclusive ownership? (Suppose that each lake is exploited by a different owner who hires the fishers and takes wages as given.)
(3) Assuming no transaction costs, which property regime is the most efficient? Is it the one preferred by workers? Explain?
(4) Suppose now that excluding access to a lake requires a fixed cost of 3000. Which property regime is efficient? Why?
(5) What would the equilibrium be if the fixed cost of exclusion were 5000 instead of 3000? Is exclusive ownership efficient?

ANSWERS

(1) **Open access**

Given the large number of fishers, it is safe to assume an open-access situation on the lakes, which we defined as an equilibrium with total dissipation of rents. In this case, this means that average products are equalized between the two lakes in equilibrium:

$$AP \equiv \frac{y_T}{x_T} = \frac{y_L}{x_L} \text{ where } x_T + x_L = 5.$$

$$\Rightarrow x_T = 3, x_L = 2 \text{ and } AP = 6 \text{ lbs/fisher}$$

$$\text{open-access total output } \equiv Y^0 = 6 \times 5 \times 10^3 = 30 \times 10^3 \text{ lbs.}$$

(2) **Exclusive ownership**

Each owner seeks to maximize rents by equalizing fishers' marginal product with the given wage rate (w). Moreover, all fishers get hired since they have zero opportunity cost. The equilibrium is thus characterized by:

$$\frac{\partial y_T}{\partial x_T} = w = \frac{\partial y_L}{\partial x_L} \text{ and } x_T + x_L = 5.$$

This yields:

$$x_T = 2, x_L = 3, w = 4 \text{ and } Y^P = 32.5 \times 10^3 \text{ lbs.}$$

(3) Not surprisingly, exclusive ownership is more efficient. It yields a higher total output with the same number of workers. (Note that here, marginal product are always positive. It is thus always efficient to hire all 5000 fishers since their opportunity cost is assumed to be nil. Once we introduce resource dynamics, however, we will see that marginal products may be negative, which means that it may not be efficient to hire all fishers even though their opportunity cost may be nil.)

If fishers do not receive any share of profits from the lakes, then they are worse off with exclusive ownership. Indeed, their wage rate is below the average harvest that they were getting from open access fishing.

(4) **Exclusion costs**

With exclusion costs of 3000 per lake, we first have to verify that owners would be willing to pay that cost, i.e. rents from the lake must be above 3000. In the exclusive ownership equilibrium, it can be verified that rents on lake Tilapia are equal to $\pi^T = 8000$ while on lake Loyola they are equal to $\pi^L = 4500$. Hence, exclusive ownership can still be an equilibrium.

Compared to an open access regime, exclusive ownership thus results in a net output value equal to $32500 - 6000 = 26500$. This being smaller than the total value of output in open access, the exclusive ownership equilibrium is not efficient once we introduce exclusion costs, even though owners would still be quite willing to bear the costs of exclusion.

(5) If exclusion costs are 5000, then the exclusive ownership on both lakes cannot be an equilibrium because profits on lake Loyola do not cover those costs.

But it may still be possible to have an equilibrium in which lake Tilapia is exploited under exclusive ownership while lake Loyola is subject to open access. In order for such an equilibrium to hold, we must verify that the owner of lake Tilapia can cover his costs. The equilibrium conditions are

$$\frac{\partial y_T}{\partial x_T} = w = \frac{y_L}{x_L} \text{ where } x_T + x_L = 5.$$

This yields $x_T = 1.667$, $x_L = 3.333$, $w = 5.333$, $\pi^T = 5556$, $Y^{OP} = 14.44 + 17.778 = 32.2222$. The net value of production is thus $32222 - 5000 = 27222$. This equilibrium can thus exist since the owner of lake Tilapia can cover his exclusion costs. It is however not efficient since the value of output net of exclusion costs is lower than that of open access. Fishers are also worse off in this equilibrium than in the open access one.