Problem Set 3, part 3
Introduction to Environmental and Resource Economics, November 22, 2004
Due Nov. 29

1. Pat and Chris share a small patch of grass near the creek between their houses and use this patch of land for grazing their goats. Because of all the snow in the winter, the grass on this land grows very lush and thick. The agricultural extension service has estimated that economic returns per goat are highest when only two goats graze the land. At this level, the grass can regenerate in one area as the goat graze in another. Beyond this level, the grass has insufficient opportunity to regenerate, and the goat's feed has to be supplemented through table scraps and Purnia Goat Chow. Three goats on the patch results in a somewhat higher goat chow requirement per goat, and at four goats per patch, the goat chow cost gets to be quite high, although each neighbors can still earn some profit on their production of goat cheese and yogurt.

   Pat and Chris face the following payoffs to each choosing to graze one or two goats, conditional on their neighbor's choice of grazing either one or two goats (Pat's payoffs run across the matrix, and Chris's payoffs run down. The payoff on the left is Pat's and the one on the right is Chris'.):

	Chris grazes 1 goat	Chris grazes 2 goats
Pat grazes 1 goat:	(9,9)	(1,10)
Pat grazes 2 goats:	(10,1)	(4,4)

   - Assuming that Pat and Chris are both self-interested profit maximizers, how many goats would you expect each to graze? (What is the Nash Equilibrium?) Is this the best outcome from a social perspective?
   - Having read the Ostrom article, would you expect that each individual would in fact graze the Nash equilibrium number of goats? If not, why not? (briefly)

2. (From last week) Sasha and Chris share a small peat bog, from which they harvest peat moss, which they add to their gardens in order to improve their soil. Because of its slow regeneration rate, peat can be considered a non-renewable resource. Their yearly demand for peat is given by:

$$10 - Q$$

   where Q is the quantity of peat. They can harvest peat at a constant marginal cost of \$4. They have a two-year time horizon, and a discount rate of 10%.

   (a) Assume that the peat bog is shared, and Sasha and Chris can't store the peat in order to sell next year. (This implies that the peat bog now meets the criteria for a common pool resource.) If Sasha and Chris act only in their own self interest, how much peat would you expect to be harvested in each year? Why? What

is the present value of the social loss for this harvest pattern, relative the the optimal intertermporal harvest strategy that you calculated for last week?

(b) Sasha and Chris realize that they can develop a compost from goat dung and leaf mulch in rodent-proof compost bins at about the same cost as harvesting peat. The compost can be considered a renewable resource, as the productivity of the compost grows the longer it is allowed to compost. It takes about a year to compost completely. If they use it right away, it helps the garden some, but if they let it compost completely, it helps the garden a lot more, since more of the nutrients are available for plants. Assuming the same demand and cost curve from above and the same inital level of compost (10 units), would you expect that the optimal intertemporal use of compost would be the same as that of the peat moss? If not, why not? (Hint: consider the value of leaving some of the compost for next year–how would it compare to the value of leaving the peat moss? Also consider the relative scarcity of the renewable resource vs. the non-renewable resource. And finally, don't forget about the incentives created by discounting!)