

Sheep and Ships: Modelling Grazing and Erosion in a Warming World.

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Abstract

Pastoralism is a major activity in the World's Drylands. It is often practised by marginalised communities in Common lands presumed fit for no other use by people in poverty. With global warming the resilient livelihood systems developed by pastoralists to cope with difficult seasonal and inter-annual climatic fluctuations may break down completely. Our premise is that vegetation cover is a key control on the rate of water erosion and that land degradation leads to a downward spiral in which more erosion leads to poorer pasture and consequently heavier grazing intensities as pastoralists are forced to herd on smaller and smaller available commons. Because of poverty they are forced to graze larger herds on smaller areas to avoid complete destitution. We have developed a digital model to investigate the probable impacts of lower rainfall on the balance between vegetative production and vegetal consumption. The model simulates a set of grazing 'styles' that comprise combinations of origins (sheds, farms, settlements), routes or transports (herded by shepherd, carried by wagons, or transhumant) and animal behaviours (walk, eat, rest,). We have developed an interactive P.C.-based programme in Java using an oops-UML approach to make accessible interactive software that is low in data and computing demands and designed to be user friendly for inexperienced users. This will be demonstrated. The results of simulations of the relationship between degradation and herd size for fixed grazing seasons (1) show that theoretical economic models of fisheries depletion by Schaefer, as modified by Clark for constrained catches, closely describe the behaviour of the grazing systems in common lands revealing yet another case of common-pool-resources (CPR) depletion, (2) provide a means for examining alternative management practices for the grazing in CPR and (3) offer a possibility of evaluating the impacts of climate change on grazing systems ranging from Nomadic to paddock, in the world's Drylands.

Key Words: *modelling, grazing, simulation, commons, resources, grasslands*

Introduction

It has been asserted for many years that 'overgrazing' is the major cause of soil erosion by wash in semi-arid regions with pastoral economies. We have no doubt that any agency that removes the surface vegetation cover can and often will lead to catastrophic erosion as the cover falls about 30%. This has been demonstrated many times in the erosional literature (Elwell and Stocking, 1986, Francis and Thornes(2003) as shown in fig.1.

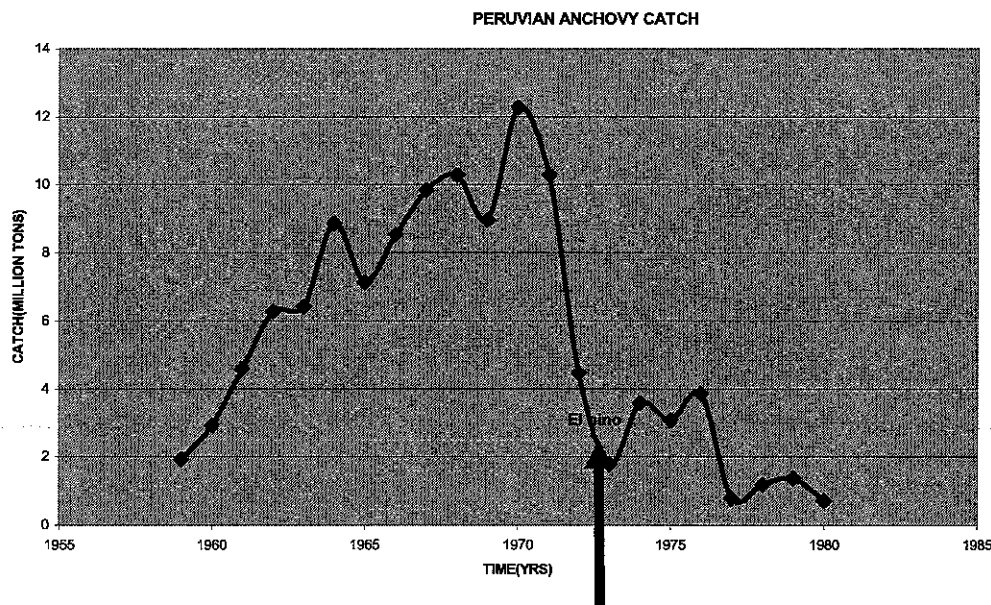
However we can and do object to the near automatic assumption that it is necessarily the cause without proper investigation. In reality the hypothesis was the subject of very little research. At the turn of the Century there was a lively and critical debate concerning the role of cattle grazing in Land degradation (see for example Behnke, Scoones and Kerven, 1993). This debate focussed on the issue of carrying capacity, the concept that there is a bounding value of the number of animals that can be grazed in a given area without causing catastrophic erosion and that this can

of the Commons expressed for land degradation. Note also that the reduction in loss levels out as the areal constraint of the paddock begin to be felt. The degradation does not continue to completion but, given the areal limit, the degradation 'bottoms' out. This is a form of regulation like that practised in fisheries. By excluding the sheep from heavily harvested areas, we have reduced the 'catch' by the sheep.

Another important dimension can be explored, the effect of climate. Fig.8 from based on data from the Peruvian Institute of Fisheries, shows how the fishing catch for anchovies climbed steeply in the sixties but that the system was so unstable that the impact of the El Nino of 1973 led to collapse of the anchovy fisheries which could not then recover. Our model is designed to test the likely impact of the coming global climate change on the global pastoral economies, subsistence and Commercial.

Conclusions.

We have presented a model that simulates the effect of grazing of the Commons by livestock in various styles. Though not yet thoroughly validated, the model shows parallels with the harvesting of fish stocks under uncontrolled and controlled conditions and reveals that the grazing problem is yet another case of the Common Pool Resources bio-economic syndrome.



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