

Human And Nature DYNamics (HANDY): modelling inequality and use of resources in the collapse or sustainability of societies

Motesharrei *et al.* (2014) – par Amaël Dupaix

It is now widely accepted that current trends in resource use are unsustainable. But the possibility of a collapse of our society remains controversial. We often consider human history as an evolution towards an increase in the quantities of information, material and energy. However, numerous articles demonstrate that collapses along human history were the rule rather than the exception, the Roman Empire and the Mayans being only two examples among several others. Different explanations were found to these collapses but, most of them being specific to each particular case, it could suggest endogenous causes.

Model construction: The HANDY model aims at providing a general framework to study the sustainability or collapse of societies, depending on several parameters. It is a human population dynamics model, based on a prey-predator model. The prey are resources, called **Nature (N)**, and the predators are human beings. The particularity of the HANDY model is the possibility for humans to accumulate **Wealth (W)**. Another difference with the classical Lotka-Volterra predator-prey model is the separation of the human population into two categories: **Commoners (C)** (producing Wealth from Nature and consuming Wealth) and **Elites (E)** (consuming Wealth). The different interactions between the four categories are represented in Fig. 1.

Results: this article demonstrates the **possibility for societies to collapse**, these collapses being of two types: L-type (Labor) and N-type (Nature). The other conclusion is that **Economic Stratification** and **Ecological Strain** can both independently lead to collapse. Concerning Economic Stratification, it leads to a L-type collapse if inequalities between Commoners and Elite are too important: E consume too much leading C to starve, C stop producing W and E end up starving too. Ecological Strain, on the other side, leads to N-type collapses: the depletion of N is too important to allow it to regenerate leading to a lack of production with as consequence starvation and collapse.

Conclusion: When economic stratification exists, collapse is difficult to avoid. Two mains reasons can independently lead to the collapse of societies: over-exploitation of natural resources and strong economic stratification. However, collapse can be avoided by reducing the per capita rate of depletion of nature and distributing resources in a reasonably equitable fashion.

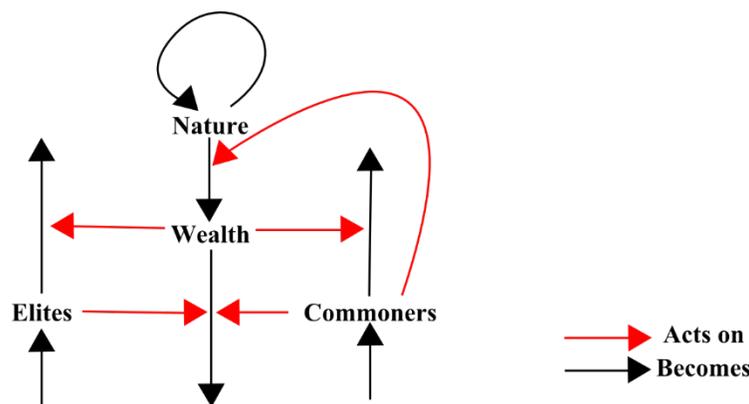


Figure 1: Interactions between the different elements of the HANDY model. Black arrows represent the transformations of the different categories (birth, death, production, consumption, regeneration). Red arrows represent the influence of one category on the transformation of another.