Source: Lozano (2007)

The Prisoners' dilemma, tragedy of the commons, Nash equilibrium, cows, and climate change

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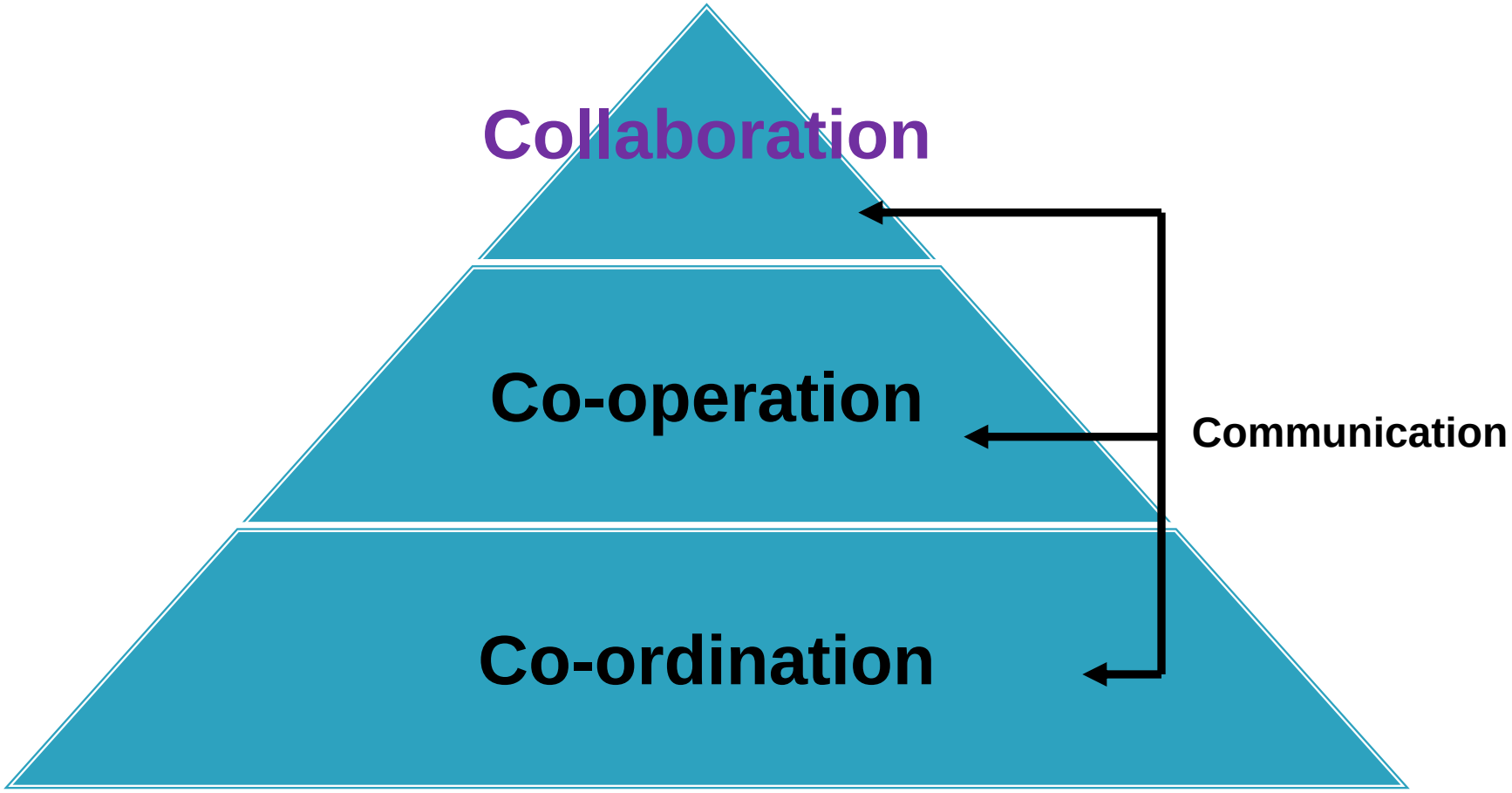
Intro

- Conventional individualistic behaviours, with their quest for profit maximization and wealth accumulation, have created economic, environmental and social **imbalances in today's world**
- One of the key elements in the **transition** towards more sustainable societies is **collaboration**

Dominant Socioeconomic Paradigm (DSP)

- Based on neo-liberalism, and dominated by Homo Oeconomicus:
  - Individualism;
  - Self-interest;
  - Accumulation of **material wealth**
- This has **created imbalances** among the economic, environmental, social and time dimensions
- DSP would not present problems if:
  - Populations would be **small**
  - The planet's resources would be **unlimited**

The collaboration pyramid



Adapted from Tunstall (2005) and Denise (1999)

Collaboration

- Action oriented
- Harvests its benefits from:
  - Differences in perspectives
  - Knowledge and approaches
  - Solving problems while at the same time offering benefits to all
- It can:
  - Optimise financial and human capitals
  - Reduce or avoid **competition** and **conflicts**
  - Reduce **time** to achieve objectives
  - Help in improving **holistic** and **systems thinking**
  - Give **trans-disciplinary** learning

Collaboration difficulties

- Costs:
  - *Coordination*: operational dependence between the activities of the different actors
  - *Vulnerability*: risk of safeguarding the important and unique resources
- Practical difficulties:
  - *Information*: who gets the benefits
  - *Bargaining*: how to split the gains
  - *Free riding*: reaping benefits without efforts

(Genefke, 2000; Chilosi, 2003)

Collaborative mindset

- How to help change from the individualistic mindset to a more collaborative one?

- Game theory:
  - *Zero sum games*: an interaction between actors one chooses his/her strategies in order to obtain maximum gain, however what one actor gains the other or others lose
  - *Non-zero sum games*: subtraction of gain minus loses can be larger than zero

Prisoners Dilemma

	A Confesses	***A Denies***
B Confesses	**Both serve five years**	**A serves ten years; B goes free**
B Denies	**B serves ten years; A goes free**	**Both serve six months**

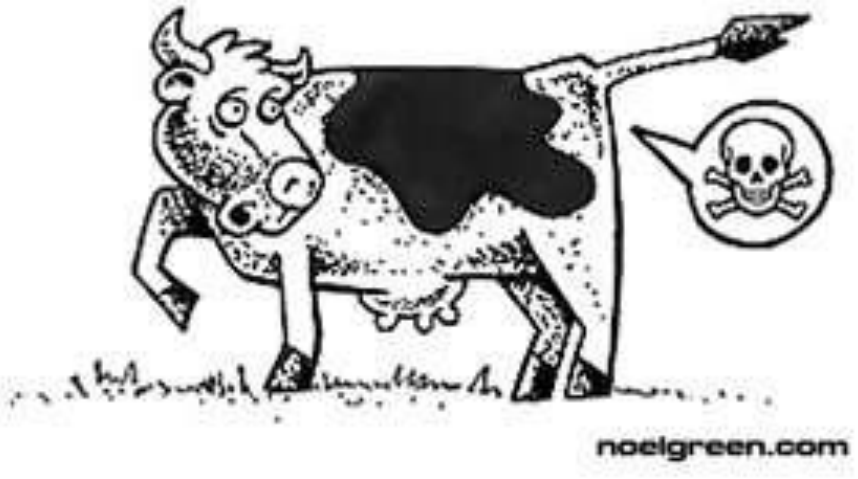
Tragedy of the Commons

- Hardin (1968) envisaged a pasture open to all, where each herdsman tries to keep as many cattle as possible in the common land, the '**commons**'.
- Each herdsman wants to **maximize** his gain by adding animals to his/her herd
- The herdsmen increase their gain from adding animals to their herds, but the 'commons' is **overgrazed**

(Hardin, 1968)

Tragedy of the Commons and Global Warming (1)

- Countries pursuing **economic growth**, usually linked to oil consumption, linked to large production and release of GHGs, requiring more use of oil to reduce the effects
- Assumptions:
  1. Purely economic growth (individualistic approach)
  2. Economic growth following environmentally orientated principles



Tragedy of the Commons and Global Warming (2)

- Under the Kyoto Protocol:
  - *Herdsmen*: the signatory countries
  - *The 'commons'*: the Earth's atmosphere (affected by GHGs)
- **Aim**: engage all countries to engage in collaborative efforts in order to obtain an optimal economic solution for reducing GHGs

Nash equilibrium (1)

- Nash (1950) developed his equilibrium to help **solve non-zero** sum games with *n players, where n is* higher than two
- Each of the players can **choose** a particular strategy according to their expectations, resulting in *n-pure strategies*

Nash equilibrium (2)

"*Any* n*-tuple of strategies, one for each player, may be regarded as a point in the product space obtained by multiplying the* n *strategy spaces of the players. One such* n*-tuple counters another if the strategy of each player in the countering* n*-tuple yields the highest obtainable expectation for its player against the* n *– 1 strategies of the other players in the countered* n*-tuple. A self countering* n*-tuple is called an equilibrium point.*" (Nash, 1950)

In short…

- The system's **optimum** is obtained when all the players have chosen their strategies that give them the optimal payoff subject to the constraint of other players' strategies' also being allowed to achieve their optimal payoff
- Thus, the **optimum is reached** when there is no benefit to a specific player or the other players if she/he changes her/his strategy

Nash example

- Two farmers (A and B)
- A pasture area with maximum capacity of 182.5 tonnes
- Grass regeneration rate of 40% per year;
- One cow's grass consumption (average) 50kg/day (18.25 tonnes/year)
- A cow is sold at the end of each year for 1,000
- Maximum number of cows for each farmer at any time is five

Nash with 3-tuple

Number of cows		*Year 1*			*Year 2*		
Farmer			*Profits ($)*			*Profits ($)*	
A	*B*	*Food*	*A*	*B*	*Food*	*A*	*B*
1	1	182.5	1000	1000	182.5	1000	1000
2	2	182.5	2000	2000	182.5	2000	2000
3	2	164.3	3000	2000	138.8	3000	2000
4	1	109.5	4000	1000	7.4	4000	1000
5	5	73.0	5000	5000	-80.2	5000	5000

Nash and global warming

- *"…a rational domestic optimum for each country would be one that best balances these two aspects [consumption and emissions]; it is achieved by maximizing its own consumption level xi with respect to ei [emissions] …"* (Chander et al., 1999)
- Each country needs to **choose its strategy** to balance its consumption and emission levels, being **constrained by the strategies** of other countries

Conclusions

- **Change needed** from individualistic to collaborative behaviours to advance towards sustainability
- A new breed of humans (***Homo Socii-Collaboratibus***) needs to take over from Homo Oeconomicus
- The PD, Tragedy of the Commons, and the Nash equilibrium can help to show that **collaboration** can help move towards more **sustainable societies** (*i.e.* reach the system's **optimum**, where everyone benefits even under the constrains of others' strategies)

‘Ruin is the destination toward which all men rush, each **pursuing** his **own interest** in a society that believes in the freedom of the commons. **Freedom in a commons brings ruin to all**’

(Hardin, 1968)

Link to paper

- Lozano, R (2007) Collaboration as a pathway for sustainability , *Sustainable Development*, **15**, pp.370–381. doi:10.1002/sd.322