ENVIRONMENTAL SCIENCE

Modelling social norms of water conservation

Social norms are the dominant behavioural patterns in a group that affect how people follow rules and regulations. A new modelling study shows, for different localities around the world, how the combination of biophysical context and social norms affects cooperation in water conservation.

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Carrots and sticks are not sufficient alone for effective environmental regulation. Compliance with regulations is also dependent on social attitudes, which vary between different cultural contexts. Social norms are expected to play a critical role in the effectiveness of collective action problems, such as managing common resources such as water and forest, or the cessation of smoking in public places[1]. How do social norms affect natural resource management? In this issue of *Nature Human Behaviour*, Castilla-Rho and colleagues[2] present a computational model in which they model social norms of farmers that affect their decision on water pumping in diverse, biophysically relevant hydrological situations. Furthermore, they use data from the World Values Survey[3] to provide a cultural context in which the farmer agents are interacting. Farmers experience governmental regulation on the pumping rates, but cultural context and social norms define whether there is compliance with those regulations.

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Computational models, so-called agent-based models, have demonstrated that cooperative behaviour can be reinforced if both social norms and norm enforcement emerge. In the classic study on the emergence of norms by Robert Axelrod[4], agents play Prisoner Dilemma games, in which they need to decide to cooperate or defect with a randomly selected agent in the population. The best joint solution is both agents cooperating; however, each agent could also benefit individually by freeriding on the cooperative behaviour of the other agent. Therefore, no cooperation will evolve without additional institutional arrangements. Besides the probability to defect, Axelrod included another trait: the option for agents to punish defectors. This leads to cooperative behaviour, but it is not sustainable as enforcement is not free. Consequently, agents start to freeride on the enforcement efforts of others, which erodes the cooperative behaviour. Only if meta-norms are included — which dictate that one must also punish those who do not follow the norm and do not punish freeriders — can long-term cooperative behaviour be achieved.

Castilla-Rho et al.[2] use the Axelrod model of social norms, but now consider farmer agents who are located in a landscape of farming properties. Illegal high pumping rates will lead to local depletion of the groundwater and thus higher economic costs to other agents. Hence a private benefit (over-pumping) leads to costs to neighbouring agents. If agents only care about their own revenue, this would lead to an overharvesting of the groundwater. However, agents are assumed to include other criteria in their decision-making, for which Castilla-Rho et al.[2] rely on the so-called grid–group approach[5]. This approach distinguishes cultural types according to the two axes: 'grid' and 'group'. The grid axis ranges from the desire for nonconformity (low grid) to the willingness to enforce social norms, even if this generates no direct benefits to the individual (high grid). The group axis represents the spectrum from a self-focused attitude (low group) to the interest of the collective (high group).

Castilla-Rho et al.[2] used data from the World Values Survey to identify the grid–group characterization of diverse nations following Chai et al.[6]. They then used the grid–group estimates of three locations to illustrate the possibilities of the model, namely the Murray-Darling Basin in Australia, the Central Valley in the USA, and Punjab in India and Pakistan. The cultural context of tolerance of non-compliant behaviour and the importance of good reputation impact how agents evaluate the decisions they can make, and the social norms that can emerge. In evaluating their potential actions, agents not only rely on the material outcomes, but also consider the value of compliance with governmental regulations in their specific cultural context. For example, in the Australian case, agents are tolerant to non-compliant behaviour, but cooperative behaviour is important for their reputation. In the Pakistan case, however, there is less tolerance to non-compliant behaviour but cooperative behaviour is less important for the reputation of the agents. Societies with high grid/high group, such as India, will be more likely to experience the emergence of cooperative behaviour.

The model implementations for the various locations differ in the relative size of the farm properties and the grid–group location of the culture. The results show that with smaller farm properties the willingness of agents to cooperation on water-restricting behaviour is more sensitive to the specific grid–group categorization. This is caused by the faster feedback between pumping rates and the costs of pumping for neighbouring agents. The model finds, therefore, that the combination of property sizes and cultural context will make compliance to governmental regulations more challenging in the Murray-Darling Basin in Australia and the Central Valley in the USA. Moreover, the USA case is close to a social tipping point, meaning that small changes in cultural context will reduce the level of cooperation. Not all relevant institutional arrangements (such as tax policies) are considered, and as such the model results need to be seen as baseline conditions rather than predictions of future events.

The work of Castilla-Rho et al.[2] is an important stepping stone towards the development of biophysical realistic models in which relevant social dynamics are captured to evaluate pathways for sustainability[7]. The stylized but empirically grounded model provides an eye-opener on how researchers could integrate models from different social and natural sciences and generate new insights about the challenges and opportunities to achieve sustainable pathways. Future research will need to validate this approach in diverse localities. If successful, this provides an approach to identifying promising transition cases around the world where modest changes in cultural or biophysical context will unlock cooperative outcomes. This will enable international agencies to prioritize hotspots to stimulate transitions to sustainable groundwater use. ❐

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Competing interests

The author declares no competing financial interests.