Inequality: Driver or Inhibitor of Collective Action?

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1 Introduction

Modern societies are characterised by rapid developments in areas including environmental and social awareness, as well as technological development. As a result of this, individual participation in the governance of the society and engagement in its development is once again taking momentum in the form of bottom-up collective action. Collective action provides the opportunity to deal with sustainability and to guarantee the expression of equal and democratic opinion (Chatterton 2016).

In addition, the overt display of socio-economic inequalities, as a side effect of modern societal developments, can also be considered a trigger for collective action movements. Most of those movements either highlight the symptoms of inequality (recall the 1-percent debate and the associated Occupy movements from 2011 onwards), or drive concrete policy solutions (here the discussion around the universal base income comes to mind).

While conventional wisdom suggests that inequality has negative effects on the success and durability of collective action (Alesina and La Ferrara 2000; Lijphart 1997), literature offers a more differentiated picture. For example, Baland and Platteau (2006) identify circumstances in which inequality can act as a driver and inhibitor of collective action. They suggest that influential stakeholders of common-pool resources (CPR) have strong incentives to initiate the management of shared resources in order to preserve the latter (and thus their influence), while less influential stakeholders benefit from shared governance (and thus equal influence) as a means to prevent overexploitation, and thus to secure their stake.

The question therefore is, if collective action can be triggered by inequalities, and acts as a means to promote equal rights and opportunities in a society, can we gain more insight into the circumstances under which inequality can sustain shared governance regimes that are to the benefit of all participants?

This work represents an initial step towards developing an integrated understanding of the influence factors (resource redistribution preferences, social structures) that drive various types of inequality, including economic inequality based on wealth and inequality in terms of social influence. A specific objective of this project (beyond this paper) is to determine their relationship to ensuing collective action, both in terms of initiation and durability.

In the following Section 2 we describe an abstract model that considers aspects found in reality, such as social alignment based on static/dynamic social relationships, and the consideration of social value orientations. In Section 3 we test selected hypotheses using the introduced model, before providing a discussion and an outlook on future developments in Section 4.

2 Model Overview

Given the well-established literature on collective action around common-pool resources, we build an abstract model of a common-pool resource management system to study the relationship between inequality and collective action. The model is based on existing theories that explain the functioning of such system and specify the correlations between different factors (e.g., resource abundance and appropriation patterns).

The model consists of one shared resource (which has an initial amount and a growth rate) and a collection of agents who appropriate from the resource. The agents survive and accumulate wealth by using this resource, although they are not entirely dependent on it. The agents in the simulation are heterogeneous in terms of wealth, social value orientation (SVO) (Griesinger and Livingston 1973), and the social influence they have on others.

– Wealth: Agents are initialised with a random distribution of wealth in a given range. Besides appropriating from the resource which adds to their wealth, the agents also contribute to it. The level of contribution is dependent on their SVO and the behaviour of their neighbours.
– The SVO dimensions are: altruistic, competitive, individualistic and cooperative. The proposed model operationalises these as probability ranges that determine an agent's preferred value distribution between itself and others (similar to Murphy et al. (2011)). An agent's orientation is chosen at the beginning of the simulation and thus defines its spectrum of value distribution.
– Social Influence: The agents follow their own appropriation patterns or copy the behaviour of their successful and influential neighbours. The social influence of an agent increases every time others copy its behaviour.

Throughout the simulation, the agents either operate in a *static* spatial environment with a randomly initialised maximum vision radius (*visionRadius*), or are segregated into *dynamic* clusters[3] (i.e., neighbourhoods) based on their relative level of contribution and appropriation (contribution-appropriation ratio). This segregation influences the social influence patterns of agents as they would only copy others in their own cluster rather than the population as a whole.

At this stage the model exploration primarily focuses on the exploration of wealth inequality (as opposed to income inequality), since it offers a more accurate reflection of socio-economic reality (see e.g., Keister and Moller (2000)). In addition, we explore the impact of social influence differences (represented as a tendency to imitate successful individuals' strategies (Bandura 1977)). The complete agent execution cycle is outlined in Figure 1 (dashed boxes indicate scenario-dependent activities).

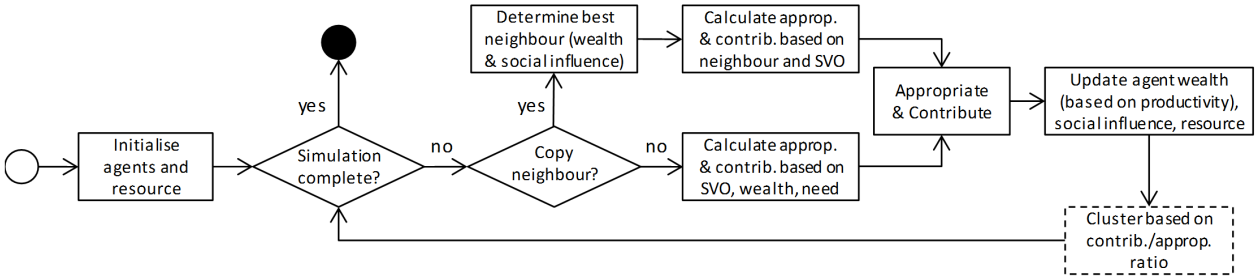

Fig. 1: Flowchart of a theoretical model to study the role of inequality

3 Model Results and Evaluation

In order to explore the relation between inequality and collective action in a common-pool resource setting, we have formulated some initial hypotheses which we explored with the model. We observe inequality in two different ways in our experiments: in terms of wealth and social influence. Our goal is to see whether any of these inequalities distributions have any relation with the state of the CPR system. The state of the system is defined in terms of the well-being of the resource, and the average wealth and distribution across the individuals in the system.

To study the correlation between the parameters we used Spearman's ρ[4], significance level 0.01, which is based on 600 runs of each model configuration. Significance tests for different initial wealth distributions are performed using the Mann-Whitney-Wilcoxon test with a confidence level of 0.95. All reported results are significant. Below we illustrate some of our initial findings:

Experiment 1: No social value orientation, no segregation

In the first experiment, social value orientation was not considered in the agents decision making. Furthermore, the agents were not segregated in clusters, and therefore, copied the behaviour of the 'best' individuals in their vision radius.

[3] The clustering is performed using the DBSCAN algorithm (Ester et al. 1996).
[4] For this initial exploration we chose Spearman's ρ due to its rank-based operation that offers a robust analysis of normal- vs. non-parametric distributions as well as tolerance against outliers.

Our null hypothesis was that highly skewed wealth distributions (i.e., high inequality) have a positive effect on the state of the resource. Our findings for this base model are as follows:

- For an exponential wealth distribution, wealth inequality has low positive correlation (0.4) with the state of the resource. For a normal wealth distribution, the correlation is low (0.26).
- For an exponential wealth distribution, wealth level has a low positive correlation (0.47) to resource level, whereas a normally distributed initial wealth distribution shows a correlation of 0.5.

Observing the relationship between wealth and resulting distribution of social influence, we can observe that

- Social influence inequality has a negligible correlation with resource state, independent of the initial wealth distribution.
- Inequality in social influence furthermore has a negligible correlation with wealth inequality, both for equal and unequal initial wealth distribution.
- The social influence level has a low correlation with resource level (equal initial distribution: 0.38; unequal initial distribution: 0.41).

These initial results show, that when the community is not segregated, and when agents make decision on appropriation and contribution levels without the consideration of their own personal values, the unequal distribution of wealth has a small but considerable impact on the well-being of the system as a whole.

Experiment 2: Social value orientation, but no segregation

In this experiment, agents considered their SVO when making decisions about their appropriation and contribution behaviour.

Exploring the impact of the introduction of SVOs on the configuration of the previous experiment, we could not observe significantly differing correlation values for initial wealth distribution and resulting resource state. However, the systematic stratification of behaviour based on SVOs offers grounds for further exploration avenues. Our first hypothesis was that a highly divergent society in terms of SVO has a positive influence on the wealth distribution of agents and the state of the resource.

Although SVO diversity did not have any correlation to the well-being of the system, we observed that selected SVOs (i.e., altruistic, cooperative, individualistic, competitive) did. For example, with equal initial wealth distribution, altruism and resource level have a correlation of 0.31 (skewed initial wealth distribution: 0.43), but the influence of altruism on the emerging wealth distribution is insignificant. Furthermore, while competitive value orientation is negatively correlated to resource level (-0.41; skewed initial wealth: -0.45), the inherently selfish individualistic orientation does not have significant impact on the resource state. Social influence levels or inequality are not correlated with SVO distributions or individual orientations.

Looking at the results, the introduction of diverse social orientations does not affect the society's performance, unless the members follow specific social orientations (here altruistic or competitive).

Experiment 3: Social value orientation and clustering (segregation)

In the third set of experiments, our goal was to see if the segregation of a society based on their ratio of contribution and appropriation affects metrics of well-being in the system (wealth levels, resource level). Apart from the focus on stratified contribution behaviour (modelled using SVOs), the unsupervised nature of clustering represents dynamic social structures based on changing group relationships – in contrast to the static neighbourhood configurations of the previous experiments.

A central hypothesis is that the introduction of neighbourhood clusters have a positive impact on wealth levels and distribution, as well as the resource state. As with all previous experiments, we further explore how clustering interacts with varying initial wealth distributions. So far, we have observed that:

- For equal initial wealth levels the number of clusters has a negligible impact on both resulting wealth levels as well as the overall resource state.
- However, for a skewed initial wealth distribution, we can observe a low positive correlation of number of clusters and resulting wealth levels (0.33). This, however, did not affect the wealth distribution across individuals, thus suggesting overall higher wealth levels. The resource level had a weak (if any) correlation with number of clusters (0.23).

– Unlike earlier experiments, social influence levels offer a low positive correlation to resource level, independent of initial wealth distribution (equal initial wealth distribution: 0.36; unequal distribution: 0.34). Looking at the social influence distribution, we further find that widely-spread social influence distributions have a low correlation with resource state in the case of non-skewed initial wealth distributions. This relationship is insignificant in the case of skewed initial wealth distributions, suggesting that an unequal initial wealth distribution makes differences in influence less decisive for the performance of the society.

Overall, these findings suggest that clusters of homogeneous self-reinforcing behaviour can lead to an overall improvement in societal well-being in situations of unequal wealth distribution. The correlations between resource state and social influence further suggest an emerging influence hierarchy within clusters.

However, the conclusive explanation of this observation requires further exploration: What is the optimal number of clusters? The low correlation warrants an identification of the optimal (presumably rather low) number and size of clusters. Furthermore, how do the individual clusters differ structurally? This requires the analysis of cluster-specific characteristics (e.g., size, wealth, social influence levels and distributions).

4 Discussion and Outlook

This abstract presents an initial step in our research on the role of inequality on the sustainability of collective action. We built a theoretical agent-based model which is based on theories of CPR systems to study the correlation between inequality and well-being of the system (see Ghorbani and Bravo (2016) for details of a similar model). Our initial results show that this correlation is more significant when a community is segregated based on their social value orientations (i.e., resource distribution preferences), as opposed to operating based on their preferences in statically assigned social environments (neighbourhoods). However, to provide more conclusive insights, a detailed investigation of the cluster characteristics is needed. An interesting model variation in this context is the consideration of adaptive social value orientations based on social influence.

Further refinements include the exploration of empirically-grounded wealth distributions that reflect contemporary human societies, in contrast to the idealised normal and exponential distributions explored as part of this work. Beyond these analytical refinements, we are currently extending our model to incorporate monitoring and sanctioning mechanisms into the model. Furthermore, we will be validating our findings by comparing the model input and outcomes with a dataset on common-pool resource institutions.

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