From Individualistic to Collective Rationality in Simulation Games for Social Sustainability

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Abstract *—This article presents the problem related to the sustainability of natural resources, in particular the common-pool resources, approached from the System Dynamics perspective and Collective Action Theory. It is stated that the rationality that makes cooperation possible among individuals is shared by these two research fields, and it is presented in this document as the fundamental source to propose preliminary orientations to design simulation games that foster a sustainable use of resources by means of the strategies that make cooperation possible.*

Keywords—Common-pool resources, sustainability, cooperation, simulation games.

Introduction

The sustainability of social systems and the sustainability of the world natural resources have been studied from diverse fields of science. System Dynamics has made studies to better understand the behavior and the policies established to solve social problems, particularly the ones related to the possible world collapse in the middle of the 21st century, caused by the progressive extinction of the world resources as has been mentioned in the books "World Dynamics" (Forrester 1961) and "Limits to Growth" (Meadows 1972, 1992). This paper intends to inquire about the strategies for sustainability of social systems proposed by these authors and about the collective rationality required to implement this strategies. The Collective Action approach provides the conceptual framework to unfold the collective rationality assumptions that supports the cooperative behavior expectations embraced by the System Dynamics social learning project. As a result of this theoretical review, some insights emerge questioning the rationality behind the Fish Banks game and offering the possibility to propose design guidelines for simulation games that foster cooperation.

From the Limits to Growth to the Sustainability, a System Dynamics Perspective.

In the book Limits to growth it is stated that: "if the present growth trends in world population, industrialization, pollution, food production and resource depletion continue unchanged, the limits to growth on this planet will be reached sometime within the next one hundred years. The most probable result will be a rather sudden and uncontrollable decline in both the population and in the industrial capacity"(Meadows 1972). The studies developed by Meadows and Forrester (Meadows 1972; Forrester 1961) are useful as tools to learn about the problem and the design of sustainability policies. However, the change in the policies has not enough to make a social system sustainable, particularly a sustainable use of natural resources in a community. It is necessary to change the way the system is perceived, in other words, world sustainability implies a change in mankind's mental models, specifically the people in charge of designing common-pool resources management policies should participate in a world wide social learning project. System Dynamics appropriately promotes a change in the perceptions and the limited ways to observe the system, to long term holistic ways that allow comprehension of causalities and effects, given that this is the essence of System Dynamics.

The book "Beyond the limits" (Meadows 1992) provides a definition of a sustainable world as: Learn, act and find ways that guide us to efficiency, to the goal that allow us subsist. The authors suggest that the management of common-pool resources is related to the quality to govern. However, a good government is not possible if new value systems are not previously defined. A new ethical, social, philosophical and political motivation is necessary to re-establish love, friendship, solidarity, sacrifice spirit and coexistence as part of our lives. "These qualities will take us to other ways of living where we all win". (Meadows 1992). These intentions apparently aim at a necessary cooperation to subsist. Taking into consideration that the book supports a global fellowship to avoid the world collapse, it seems that the authors perceive a cause of the overexploitation of resources associated with the human relations, behaviors and the individualism influencing them. For this reason, it can be stated that the motives why the availability of resources is affected is more related to the emergent wholeness of social interactions when individuals try to satisfy the own and community interests efficiently, than the shortage of the resources. "There is just exactly enough energy, enough material, enough money, enough environmental resilience, and enough human virtue to bring about a revolution to a better world" (Meadows 1992).

Forrester, Sterman, Senge, Moxnes (Forrester 1971; Sterman 1989; Senge 1990; Moxnes 1998), have shared the concern regarding a deep comprehension about how the individuals make collective decisions in social systems, particularly how to provide tools to improve the sustainable use of natural resources. They articulate their research about the difficulty that human beings have to understand the implications that decision making suggests. That is the reason why they have developed experiments that include abstractions and simulation games that allow the creation of decision making situations in the real world.

Within the variety of simulation games that have been designed, the first that focuses on sustainability of common-pool resources is "Fish Banks" (Meadows 1987). This is a game that has been used as an instructional tool to teach a sustainable management of the fishing industry, achieving a closer comprehension of what the management of natural resources implies; and understanding how the system can take rational fishermen to the extreme situation of depleting their own fish supply in an irrational way. The game provides the possibility of experiencing the initial great benefits to the sudden collapse and depletion of the fishing industry.

Fish Banks seems to be a first instrument to promote a type of learning that aims at the emergence of the global fellowship assumed as a condition to provide sustainability to the world natural resources. However, Fish Banks has also been used as just another simulation game for management, clouding the original meaning of the game.

Fish Banks illustrates competitive behaviors and evidences a non-systemic management. It promotes a change of attitude more related to the recognition of individualistic behaviors and the negative consequences for all the members that economically depend on the resource. In other words, Fish Banks has been a helpful tool to identify the problem of depletion of resources but it seems limited on the actions that preserve the resource which implies benefits for everyone involved. The conceptual framework that enriches this argument is developed in the section below.

It can be observed that System Dynamics has made efforts oriented to understand how the mental models and to design and study the tools used by the people involved in the decision making process related to common-pool resources management, influence the sustainability of social systems.

Sustainability and Collective Action

These same sustainability issues have been studied from other scientific fields. During the last decades, an interdisciplinary field which has been interested in understanding the rationality that makes a group of individuals behaves like a cohesive collectivity, has been built and it is called: Collective Action. As a consequence, this field is interested in studying the cooperation phenomenon among individuals. The conceptual framework used in this field is the one provided by the Game theory.

The Prisoner´s Dilemma has been used to understand the nature of human cooperation from the Game Theory (Campbell 1985). In this game, it is assumed that each player, in an independent way, tries to maximize his own advantage without caring about the other players´ outcomes. Each player could choose the option of betraying the other player but in spite of this, curiously both players would obtain a better result if they cooperate. Unfortunately , each player is individually motivated to betray the other, even when they had promised to collaborate.

Through this game, the model of the "Tragedy of the Commons"(Hardin 1968) has represented the degradation of the environment as a result of many individuals using a common resource at the same time. The problem of excessive exploitation and the depletion of a common-pool resource arises when numerous individuals or communities use at the same time and in a collective way the same resource without excluding anyone of its use and trying to obtain the most advantage of its exploitation, causing the depletion of the common resource. This non-systemic behavior is caused because the individuals that are receiving benefits from the common-pool resource, behave in an individualistic way and care less about the consequences of their actions on the collective well-being.

At present the depletion of most of those resources, due to the accelerated deforestation and the destruction of ecosystems that are essential to the sustainability and world equilibrium, has created regulating solutions like the establishment of National parks, population planning and appropriate management of the ecosystems and the species. These solutions have favored the preservation of some of the natural resources. However, most of these solutions have been either Government intervention or the active participation of private agents (Ostrom 1990).

The first type of solution is based on the statement that the human being is selfish and incapable of thinking and acting towards the common welfare. As a result, the common-pool resources require a public control to avoid the depletion of the good (Hardin 1978).

The second type of solution focuses on the creation of private property rights on the common property to guarantee the efficacy and sustainability of the use of the exploited good (Ehrenfield 1972). However, according to the statements above, it can be observed that any of the implemented strategies, neither from the State nor the market intervention, have caused the expected results. This has been the case of the third world countries where this kind of restrictive rules have been implemented for the regulation of some common-pool resources (Ostrom 1990, p.36).

In spite of this inefficient use of common-pool resources, it can be stated that there are some successful cases in indigenous communities and other collectivities in which the "self-governed common-pool resources" has been implemented.

The regulation theory contradicts in some way, the existent agreement based on the theory presented by Hardin which argues the impossibility of cooperation. In opposition to that theory, the theory of collective self-government is based on the capacity to achieve and meet rational agreements among the participants towards a sustainable exploitation of a common-pool resource putting aside self-interest strategies to create coordinated strategies to obtain better common benefits or to reduce environmental damages.

Based on game theory and the collection of empirical data, Ostrom and other authors dedicated to the study of the tragedy of the commons, have created models representing situations related to the use of common resources that has been applied in both

industrialized and third world countries. The research strategy is thus related to developing the experience that captures the aspects that are determinant when the participants make decisions about the use of common-pool resources and represent these aspects in a game. The game would be the mirror where the involved participants can realize about the essence of the problems that they are facing.

Starting with the kind of rationality assumed by the Collective Action authors, it is necessary to bring to light the theory of rational choice, in which the individual faces the decision making process in reality making the best effort to choose the decision with which he would obtain the best results. Based on this fundamental assumption, Mancur Olson in the book "The Logic of Collective Action" (Olson 1965) states the following assumptions about the conditions that make the collective action possible:

1. The groups themselves do not have collective. Participants only have individual interests.
2. The participants act in favor of their own interests, choosing action only when the possible benefit exceeds the awaited cost.
3. Even though the participation is expensive for an individual, the goal that a group can achieve if they cooperate is beneficial for all the members.
4. The participants can not be excluded from the collective benefits of the goal if it has been successfully achieved.
5. The participants do not take into consideration the effect of others' decisions when deciding to cooperate or not.

The assumptions above show the collective action theory, seen from the Olson´s perspective, based on an "individualist rationality", where the election of cooperate or not to cooperate is the result of calculating the individual cost and benefits. It can be said that the collective action here is motivated by the economical incentives that an individual can obtain caring less for the benefits that can be achieved if others cooperate. In Olson´s own words "Unless the number of individuals is quite small, or unless there is coercion or some other special device to make individuals act in their commons interest, rational, self-interested individuals will not act to achieve their common or group interests".(Olson, 1965, p.2)

When the collective action is understood from the Game Theory conceptual framework, it is evident that the situations where the individual use rational choice it is when there is an strategic situation. In this kind of situations the individual, before making a decision, needs to guess what the others are going to do and also guess what the others think he would do, in other words in strategic situations an interdependence among the decisions of the individuals emerges.

According to Medina (Medina 2002), in the case of the use of common-pool resources in a community, the election problem that the individuals face to foster collective action, is beyond the economical incentives that they can achieve in an individualistic way.

According to him and other authors (Schelling 1960), a possible solution to this problem must be a change in the cost and benefit structure in a way that they find it attractive to cooperate. Selective incentives appear here as a conceptual device increasing the recompenses that the individuals obtain if they behave in a cooperative way. The crucial aspect of selective incentives is that they need to compensate the individual on the cost of the collective participation. In other words, the incentive should exceed the cost of cooperation and that way individuals are more willing to do it.

For Medina, cooperation is possible when the benefits obtained because of the cooperation are higher than the benefits obtained individually, so even from this perspective the decision of cooperate in the common pool resource is related to an "individualistic rationality", like it does happen according to Olson. However, Medina states that the Olsonian conceptual framework has a limitation related to the assumption that individuals are not rational enough to comprehend the advantages of cooperation when making decisions associated with common pool resources. From this perspective, when the individual faces a collective action problem, he does not focus only on the individualistic assumption but he also is influenced by his beliefs about the behavior of other individuals (Elster 1989). In other words, to make the decision to cooperate or no he is based on both, the cost benefit analysis of the selective incentives and the mental models about the possible action the others would take. This is called the "strategic rationality". If the individual has the belief that the others are going to cooperate, he would make the decision to cooperate as well, based on the incentives and in his beliefs about others, then he would be more willing to cooperate. The contrary case occurs when the belief about others' capacities to cooperate is individualistic (free-riding) in which he would only make the decision based on the selective incentives.

At this point, Ostrom´s Collective Action theory (Ostrom 1990) is approximating Medina´s assumptions about the strategic rationality, because according to the author , despite of the fact that the principal motivation to cooperate in common-pool resources in a community are the economical incentives, there are some rules of self-government that helps the individuals be aware about the cooperative behavior that others can have. This belief about others´ cooperative behavior is achieved through the construction of norms that are shared and internalized by the community. These norms motivate important factors that are essential to cooperate: trust, reciprocity and reputation.

The set of norms and agreements (fines, restrictions, rights, information, awards) establishes collective self-governed institutions, where the election of the individual to cooperate depends on:

1. The knowledge about the system (scientific – traditional). In other words its structure, limits and internal characteristics.
2. The cost-benefit evaluation (discount rate – selective incentive) of the actions to take.
3. Perception of the possible results (short and long term).
4. The number of people making decisions.

5. The similarities of interests among the individuals, norms of behavior (common – constructed).

According to the statements above, the election to cooperate in common –pool resources, considering Ostrom´s theory of collective self-government, would be based on a "strategic rationality". This conception of rationality suggests that the cooperation of individuals in a community results from the individual interests, but in certain circumstances they become collective interests when the community achieves to behave in a cooperative manner.

The Rationality of System Dynamics Simulation Games

According to "Limits to Growth", it was clear that the sustainable development depends on the human elections and on a change on the mental model that assumes growth as the only possible alternative for a better world.

Therefore, the proposal to diminish these effects is basically to get organized and control the resource in a collective way through a kind of learning based on the experience that facilitates the estimation of risks in the short and long term and thus to achieve a deeper comprehension of how the system behaves overtime. These issues will allow the participants to have clearer perceptions about the system, the causes that are creating the situation and therefore they will foster the conditions to make better decisions oriented to "managing" the resource in a way that everybody wins. But "Beyond the Limits" also makes a call for a global fellowship to avoid the world collapse. This perspective demands more than an individualistic or even strategic rationality, it requires some kind of collective rationality. What type of rationality is promoted by the Fish Banks game? A preliminary answer to this question was presented earlier. An enhanced answer can be proposed based on the conceptual framework of Collective Action.

Collective rationality, which can be represented by cooperation initiatives, is not deeply developed when experiencing this game. In Fish Banks, players care the common resource basically to sustain their private benefits, that is, they are aimed by an individualistic rationality. However, when each player compares the outcomes with or without cooperation, he needs to take into account the predisposition of others to cooperate before to make his own decision to cooperate. So, there is also a strategic rationality moment during the game. But rules of the game do not promote cooperation initiatives, the Fish Banks game does not completely realize the collective rationality implied in the idea of social learning stated by "Limits to Growth" and "Beyond the Limits".

Guidelines to Design Simulation Games

The context in which the sustainability decisions are made involves uncertainty, complexity, limited resources and contradictory human interests and values. That is the reason why some of the orientations for design that this document suggests for the

instructional use of common-pool resources simulation games, are referred to: the knowledge that participants can have about the system, the possibility to low the levels of uncertainty when making decisions, the availability of information about past experiences managing the resource, the possibility to support multiple players and diverse roles, to construct rules that guide the decision making process and to test and redefine strategies to behave in the simulated reality.

First of all, it is clear for the two fields that one of the strategies that foster cooperation is focused on the capacity of individuals to comprehend how the system works. This can be understood as the comprehension of the causal structure, the feedback cycles, the system limits and the growth rates. They all conduct to decision making process more aware of the dynamic of the resource and the possible effects that those decisions will have on the availability of the resource in the short and long terms.

At the same time, this information would reduce the uncertainty that is part of the decision making process which will allow participants to create agreements where the collective benefits promotes the sustainability of the resource.

Simulation games must provide the possibility to create, refine and test strategies for cooperation, based on rules previously defined by the players, that influence the decisions in the simulated system before they can be implemented in the real world. This way it is expected to reduce the level of risks that can affect the sustainability of the system, but this learning experiments also foster the type of collective rationality required by a deep and world-wide social learning proposed in “Beyond the limits”.

A multiplayer simulation game provides the possibility to know the decisions of all the other players, which allow participants to reinforce the beliefs about how others cooperate. These beliefs are expected to increase the levels of trust, reciprocity and reputation, issues that are essential to cooperate.

Simulation games provide the possibility to represent the complexity of the agreements and negotiations that emerge from the variety of roles, rules and the possible behaviors from the participants when they are involved in a double loop cycle that facilitates the exploration of mental models and the design of strategies that foster the achievement of a common goal and in the long term, the sustainability.

This ongoing research proposes the creation of simulation games that include, as part of the design, the preliminary orientations mentioned above, and at the same time, develop experiments in a community that economically depends on the common-pool resource, based on the designed games that are expected to promote in the participants a strategic rationality influenced by the conditions that make cooperation possible.

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