



A theoretical synthesis for the governance of dynamic and complex coastal and marine socio-ecological systems

Sessão Temática: 7. Economia ecológica, economia política e pluralismo metodológico, heterodoxia e economia ecológica

Resumo

Este artigo explora a complexidade e a adaptabilidade dos sistemas socioecológicos através da análise de dois referenciais teóricos separados, meramente a economia ecológica e o neo-institucionalismo como pontos de partida para a elaboração de sistemas de governança sustentáveis e justos. Instituições e agentes são componentes centrais para a síntese dessas perspectivas

Palavras-chave: sistemas sócio-ecológicos, complexidade, adaptabilidade, neoinstitucionalismo, sistemas de governança

Abstract

This article explores the complexity and the adaptability of the socio-ecological systems through the analysis of two separate theoretical frameworks, merely ecological economics and neo-institutionalism as points of departure for the elaboration on sustainable and just governance systems. Institutions and agents are central components for the synthesis of those perspectives.

Key words: *socio-ecological systems, complexity, adaptability, neo-institutionalism, governance systems*

1. Introduction

The relatively recent literature on ecological economics have explored a synthesis of ecological science and economics (Fisher et al, 2008), demonstrating how nature, or else ecosystems provide services beneficial for human well-being, as well as early efforts to combine and systematize knowledge through interdisciplinary approaches in order to overcome analytical obstacles that presented due to the high complexity of the matter. Hence, ecological economics managed to establish new perspectives in analyzing issues related to the so called “natural capital” and further evolves by intercepting with other disciplines. In this vein, this present article presents links and common points among complexity, environment and institutions for the redefinition of the governance models through the analytical tools of ecological economics and neo-institutionalism.

In order to present analytically the first session is dedicated to complexity in socio-ecological systems as perceived by ecological economics theory. The second section discusses how institutions and institutional change is key to adaptation under the neo-institutional approach. Finally, the third section explores the different systems of natural resources governance.

2. From nature to the complex and evolutionary socio-ecological systems

From an anthropocentric perspective, the ecosystems provide actively or passively services from which human societies benefit directly or indirectly to survive, and to develop their economic, cultural and social activities (COSTANZA et al. 1997). Vice-versa, the anthropic multi-faceted interactions with their environment affect the generation of those ecosystem services, in many cases drastically considering economic and population growth as well as climate change phenomena (ANDRADE; ROMEIRO, 2009). The complex, dynamic, adaptive and multilevel ecosystems exhibit properties of both variability and resilience that affect their structure and patterns of nutrient stocks and flows by continuous and stochastic interactions between biotic and abiotic components, and by systemic reaction to shocks, so that the original equilibrium can be recovered, given that the tipping point of the system is not surpassed, respectively(ANDRADE; ROMEIRO, 2009).

Otherwise, anthropogenic degradation of the ecosystems due to extraction, landscape alterations and wastes may result to irreversible damage to its primary functions that maintain and perpetuate the system. In view of the increasing risk of the collapse of ecosystems and

therefore of their services, the thorough understanding and consideration of the dynamic evolution of the ecosystem flows in conjunction with human activity becomes more relevant to be considered in the decision-making analysis to enhance the adaptive capacity of the system (ANDRADE; ROMEIRO, 2009).

Ostrom (2009) defends the position that the challenge lies to identify a general classificatory framework that will guide scholars in each phase of the identification process, including data collection, fieldwork or analysis, of the type of arrangements for collective action and self-organization that sustain specific SESs or on the contrary, collapse them.

By definition, the SESs are, or else result from, the intrinsic connection of the social and ecological systems consisted of a total of subsystems, which interact horizontally and vertically, bringing mutual effects on subsystems, the whole SES, and other SESs of bigger or smaller scale (DE MESQUITA NORA *et al.* 2017). In more detail and in establishing an analogy for the fishing sector, the authors perceive the subsystems to include: a) the resource systems, such as the marine fish stocks; b) resources units, such as particular species; c) systems of governance, such as local arrangements among government and other organizations responsible for the management of fishing; and d) the resource users, such as the artisanal fishers in coastal areas.

For each subsystem, Ostrom (2009) proposes a nested framework of potentially relevant 10 subsystem variables in multiple and deeper analytical levels depending from the issue and the dimensions, both time and space, of the SES under analysis. Among the distinguished variables, some are subject of analysis in this dissertation, including i) number of users, ii) leadership, iii) norms and social capital, iv) knowledge on the SES, v) significance of the SES to resource users, vi) collective-choice rules that determine how and who can participate in processes of changing operational rules (SCHLAGER; OSTROM, 1992), as a first step to establish a better understanding of the SESs.

Moreover, in the study of Ostrom (2009) on the potential catalysing disturbances in SESs across spatial and temporal scales, complexity is presumed to be integral part of the systemic relationships that should be further explored rather than eliminated. The perception of complexity of the institutional matrices appears also crucial for Chang (2010) in this criticism of the mainstream discourse on institutions and economic development. According to Chang (2010), the static, linear and one-way causations between those elements are based on weak evidence which ignores important features of heterogeneous systems, as exist in real-life. Furthermore, the term socio-ecological systems (SESs) invites for more holistic approaches by not isolating socio-economic systems from the ecosystems within which the

former operate. Instead encompasses various dimensions that inter-depend, but yet evolve separately, thus, adding several levels of complexity to any analytic approach.

The non-linear causal interrelations, fluxes and feedback loops of the processes of both natural ecosystems and anthropic interventions create dynamic and evolutionary equilibria that does not always guarantee socio-economic prosperity, especially for social groups whose quality of living conditions depend directly from ecosystem services, considering a conjunction of ecological limitations, the technological advancement that permits greater and faster accumulation of knowledge and economic development, or the cultural value systems (ANDRADE, 2015). Notwithstanding, SESs need to demonstrate resilience and robustness (ANDERIES et al., 2004). According to the authors, the first refers to the ability to maintain its function by changing processes and/or structures after surpassing tipping points of spiral down irreversible consequential impact, while the second refers to the effort of maintaining performance under circumstances of uncertainty, merely by calculating trade-offs though without having easily measurable output or input values or its components.

3. Ecological economics as a new universe for public policy analysis

In view of the necessity for adequate public policies, Fisher et al., (2008) suggest the incorporation of the concept of marginal ecosystem changes and/or ecosystem transition states to accelerate policy decision-making by securing a “*safe minimum standard*”, or else “*a minimum quantity of minimum quantity of ecosystem structure and process*” to maintain its sustainability, not without attributing the analogous use of ecosystem services to relevant social groups conforming institutional and cultural conditions. The authors choose through the categorization of the ecosystem services to intermediate or final, as well as services or benefits, The latter is generated in combination with the available capital in a given institutional framework and under adequate scale for each case, while securing that any measures to secure provision of such ecosystem services maintain the system under relevant stable transition path to another, or else the “*precautionary principle under continuing uncertainty*” as oppose to abrupt and unpredictable bursts in case that the resilience tipping point is surpassed. Accordingly, Fisher et al. (2009) also point out further the demand for a solid classification for the ecosystem services in correspondence with the realities of the socio-economic system in various scales.

Furthermore, the challenging development of a multi-criteria valuation system to assess ecosystem services with both monetary and non-monetary values depend highly from the adopted approach; whether it is anthropocentric, strictly environmental or ecological considering also socio-cultural dimensions. The analytical universe of the environmental economics presupposes that the ecosystem, a pool of inputs and outputs orbit around the economic system with its development goals of expansion, while the ecological economics reverse its center of gravity by revealing the economy to be a subsystem of a finite global biosphere. In other words, negative externalities and anthropocentrism perceive environment as an input and output component to economic activities, that is translated to pollution and natural resources theories, while ecological economics offer a more pluralistic approach reinforcing the biophysical and ecological aspects, rather than the economic system, and acknowledging the multiplicity of involving factors, the analysis of which encourages for more interdisciplinary approaches (ANDRADE, 2008). Ecological economics argue against the optimism that generates the technological advancement or the weak sustainability of the constructed capital as a substitute to the natural capital for the well-being and the optimal allocation of the natural resources.

4. Institutional change as a valuable tool for SESs

Institutions are typically set in order to maintain stability in the system, but Anderies et al. (2004) argue that institutional robustness might not be contributing appropriately in the dynamic circumstances of the SESs that undergone changes. The quest of identifying and evaluating institutional change is valuable for a better adaptation to the mutations of the already complex coastal and marine socio-ecological systems (SESs) triggered by human-led, accelerated, dramatic changes in the environment. Andrade (2015), having into consideration the “bridging concept”, which refers to the transversality of the “natural capital” with the human condition, or else, to the ecosystem services that are fundamentally beneficial for the achievement of both tangible and intangible socio-economic goals, adopts a interdisciplinary system-thinking approach to recreate an analytic model for the selection of the more ecologically relevant components, as well as of both internal and external ecosystemic processes at the appropriate spacial and temporal scale.

In order to extract conservation strategies, the model need to guarantee a fundamental understanding for the dynamic structure of natural capital considering simultaneously the trade-offs of the economic development, on the premises of its finite expansion within the

limitations of our ecosphere, as well as the culture and the role of the relevant stakeholders who govern, manage and depend from the use of ecosystem services, the so-called social capital (ANDERIES et al., 2004). Since the institutions at various levels of analysis not only are based on those cultural evaluations but also can form new ones in a dynamic way and thus affecting strategies and public policies regarding the conservation and management of the natural resources. Yet, the real life complexity renders SESs more random results due to the operational set of rules and the collective-choice which is unpredictable and subject to strategic manipulation by agents.

5. Neo-institutional perspective for institutional change

The fundamental concept of interdependence is adopted from the neo-institutionalistic approach as a counterpoint to the view of environmental issues as externalities (PAAVOLA; ADGER, 2005). The authors perceive agents' decisions and actions on finite natural resources to be mutually interdependent, but not always harmonious due to their heterogeneous interests, values, goals and socio-economic status, which, inevitably lead to conflictual circumstances that governance institutions are called to address. The total range of formal and/or informal institutions at local, regional, federal, national and even international level that resolve such issues by establishing or reallocating endowments, and, thus, bringing further allocative and distributive repercussions and, in general, manage all renewable and non-renewable natural resources, is what the authors define as environmental governance (PAAVOLA; ADGER, 2005).

To secure its effectiveness, the institutional design must adhere accordingly to the spatial scale of the emerging issue related, for instance, to the distribution and/or use of the natural resources. Yet, the inherent complexity that emerges from the various patterns of interconnectedness, depending in each case from the inherent features of the resource itself and its potential users, demands for multiple institutions to join efforts, and calls for particular attention to be paid to socially just solutions for both present and future generations. Moreover, the pluralistic configuration of the micro, meso and macro institutional structures vision to internalize mechanisms of reallocation of rights and obligations, not necessarily restricted to adhere the present circumstances of a specific SES, but may also expand to establish inter-temporal efficiency at various spacial scales, through policy-making and bureaucratization processes (ALCOFORADO, 2001).

The neo-institutional approach as means to adapt governance in complex and evolutionary coastal and marine SESs is explored also by BALLESTEROS et al. (2011) in an attempt to set dynamic regulatory framework that would restore or cease the deterioration of the coastal and marine ecosystems, and, simultaneously, enable sustainable fishing activities. Accordingly, the role of both formal and informal institutions is highlighted by pointing out its varied, interconnected facets as: (a) architects of game-rule setting that define and affect behaviour of the various agents by establishing rights and obligations; (b) facilitators that reduce the transaction costs and optimize governance; and (c) mediators that establish what the authors call the conditions for “symbiosis” among the dynamic ecological, social and economic vectors.

6. Governance systems for SESs

In this article, the role and purpose of governance, though not limited to, is considered to be the coordinator role among agents with the purpose to reduce risks, correct biases and thus, reinforce the resilience and robustness of the system to secure SES that support human well-being. The current governance models are deemed inadequate to deal with extraordinary, accelerated and multi-scale phenomena that affect not only the sustainability of the ecosystems but also the social and economic well-being.

Governance models based on different scales and SESs is a major challenge, especially in territories of coastal states where the complexity increases considerably due to their connection to the marine environment. The traditional top-down model, especially in the natural resources governance, is deeply challenged for its rigidity and for not allowing adequate representation from other affected actors, including a range of organizations that are neither public or private; the so-called third sector among which we may include universities, institutions, NGOs, social enterprises, associations. Those entities, considered to be independent, value-driven and with no governmental affiliation, have claimed a greater participation in decision making and implementation on the basis of expertise, social justice and democratic values, such as transparency, accountability and social equitability.

Anderies et al. (2004) identify two principal components, merely the resource users, and the public servants, whose behaviours depend from partial, incomplete or imperfect information sets regarding the institutions involved and the state of SES, respectively. The governance of such systems then to address the lack of consolidation of the available information to optimize decision-making procedures, especially in cases when different

individuals occupy roles that correspond to the components as mentioned above. Accordingly, Anderies et al. (2004) argue that collective-choice governance systems that allow for actors to participate both to decision-making and execution are more enduring in conditions of stable disturbances.

Newig and Fritsch (2009) by conducting a meta-analysis of 47 case studies in Northern America and Western Europe, conclude that highly polycentric governance systems yield higher environmental outputs though causal relations could not be identified either between governance effectiveness and the decision-making scale, or policy delivery and institutional fit to ecosystem. It is worth mentioning, another conclusion of the empirical findings of Newig and Fritsch (2009) is that the involvement of non-state actors in the governance does not significantly increase the utility of local knowledge and the potential of social learning for achieving more sustainable outputs. Though this study excluded Latin America, those conclusions are valuable in the quest of polycentric regimes which recognise and mainstream local environmental knowledge.

The low efficiency of “trial and error management” of small-scale fisheries despite successes in regulation and cases of self-regularization, lead McClanahan et al. (2009) to encourage a process of “cross-fertilization” among goals that target environmental and social sustainability through a mix of proactive multi-scale participatory co-management of natural resources and socio-economic incentives. Still, the preconditions for such endeavours, such as the creation of forums, professionalization, promotion of social rules more adherent to the SESs and the use of diagnostic tools, demand separate analysis within the complex local realities. The policies and institutional arrangements for small-scale fisheries in Brazil demonstrate that the proposed policies and actions are not enough as long as fundamental socio-economic circumstances and overarching public policy goals are not adapted to such efforts.

Particularly, committees for the management of common natural resources are long institutionalised, though those bodies have not matured enough to reassure either fair representativeness or means to push forward their agenda. Moreover, the artisanal fishing colonies and the fishers’ associations resist efforts for professionalization of the craft, in terms of on-board security measures, fishing points, and instead most members opt to neglect regulations and rules in detriment of natural ecosystems. Also, despite international commitments and the 2030 Agenda that guide the mission of the central governmental institutions, public policies in practice send controversial signals to local societies for developmental goals that do not necessarily combine with social justice and environmental

sustainability. Notwithstanding, inputs from the accumulated intergenerational ecological knowledge of local artisanal fishing communities is either neglected or not properly juxtaposed with conventional scientific approaches.

The consideration of complexity is essential for the thorough understanding of the challenges facing SESs regarding not only climate issues but also the use of natural resources, such as water resources. For instance, gradually, water governance over the years evolved into more complex structures: the introduction of the hydrographic basin/watershed principle redefined the political and administrative spatial jurisdiction on actual geographical scale of the principal inland water bodies. Also, during the consequent changes in the institutional framework, heterogeneous agents, including government, market and civil society, emerged as potential contributors at moments of strategic shifts despite the fact that all of them proved to be part of the problem and its solution simultaneously (Pahl-Wostl, 2015).

As North (1990) points out diverse multi-scale institutional arrangements and complex motivational structures may generate outcomes that are productive and innovative or, on the contrary, destructive and perverse. Evans (2008) supports the adoption of creative and flexible synergies for diversion from public bureaucratic and deliberative institutions of the “developmental state” which will continue to play a crucial a role in economic growth and social transformation in the 21st century. The author envisions instead a knowledge driven participatory economic development targeting well-being (both target and as means), based on the expansion capabilities theory of Amartya Sen, and development depending on the generation of intangible assets (ideas, skills, and networks). Networks as formed in the public spaces or the e-spaces interrupt the traditional institutional loops allowing experimentation towards new institutional settings for participation and co-formation of rules.

According to (OSTROM, 2005; apud KINGSTON; CABALLERO, 2009) this innovative political-bargaining process in institutions might be effective in cases where bounded rationality and risk aversion prevails leading to unwillingness to perform changes, especially when there is an incorrect understanding of the effects of potential changes, though the challenge lies upon how the existing institutions will accompany this transitory procedure and how to reassure positive attributes to the societies. Koontz *et al.* (2015) in an effort to trace causal relations consider networks and learning procedures to be fundamental variables of their theoretical framework on institutions that change in order to maintain or improve to a desirable state.

Still, the authors acknowledge that the networks depend form the specific historical and socio-economic context, including rule compliance, power pressure groups, social capital,

the interactions of scales and biophysical conditions, transaction costs, and overlaps among other variables. Equivalently, in the absence of homogeneous collective interests or compensation for potential losses, Kingston and Caballero (2009) suggest that power asymmetries among or in the pressure groups could lead the most powerful to block or impose inefficient change through coalitions or rivalries, which, in the case of institutional settings that provides more autonomy for differentiated policy-making, could generate further fragmentation (AFFONSO, 2003) instead of consolidated institutional networks.

7. Conclusion

This article demonstrate a dialectic synthesis on the fundamental elements of the ecological economics that re-establishes the focus of the theoretical analysis beyond the socio-economic systems which are the centre of the environmental economics, and the neo-institutional economics that acknowledges the dynamic complexity of the real world within which formal and non formal institutions operate as well as the plural behaviour of their agents. The combination of the theoretical perspective of both ecological economics and neo-institutionalism provide a thorough basis for more innovative and interdisciplinary solutions that vision intergenerational sustainability and adaptation to climate change effects. Such theoretical considerations enlighten the issues of the socio-ecological systems in search for more effective and just environmental governance solutions, such as in highly complex and dynamic coastal and marine environments. More specifically, it is proposed to vision the governance models as strategic tools that serve to guide institutional changes by adapting ground rules for stakeholders complex interactions, levelling the transaction costs from one institutional status to another, and by using all possible inputs that establish innovative management systems for the coastal and marine ecosystems. In this process, institutional change is the purpose and the governance models are considered to be strategic guiding tools contribute to the process by forming and controlling the setting rules, transaction costs and inputs.

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