



Territorial embeddedness of natural resource management: A perspective through the implementation of Industrial Ecology

Juliette Cerceau^{a,*}, Nicolas Mat^b, Guillaume Junqua^c

^a Université Grenoble Alpes, 14 Avenue Marie Reynoard, 38100 Grenoble, France

^b PIICTO Association, France

^c Ecole des mines d'Alès, 6, avenue de Clavières, 30 3019 Ales Cedex, France



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ABSTRACT

We address the territorial embeddedness of resource management: the way in which resource management is shaped by the territorial context in which it occurs, as well as the way in which resource management contributes to shape new territories. We demonstrate that Industrial Ecology (IE), as a specific resource management approach, can be used to gain new perspectives on territorial patterns emerging with resource optimization. First, we lay down a theoretical framework that should underlie the use of territory as a concept, building bridges between geography and IE. Then, drawing upon this theoretical framework, we develop a methodological structure that can lead to and manifest the process of territorial construction at work in IE. We test the knowledge production capacity of this theoretical and methodological approach to territory in IE by applying it to a specific case study in the Aix-Marseille Provence metropolitan area (France). This paper thus enhances knowledge about the territorialization process at work in IE, by identifying different IE territories within the same geographic area and positioning local stakeholders, understood as local inhabitants, with respect to territorial interfaces. Finally, we discuss how IE, as a specific resource management approach, questions the different aspects of the connection between people and geographical places in a natural management context.

1. Introduction

Territorial strategy and resource management are deeply connected. On a global scale, spatial strategies and multi-actor territorial practices for conservation and development reconfigure resource access, control and management, shaping the human-environment dynamics (Bassett and Gautier, 2014). Rassmussen and Lund (2018) observed that new patterns of resource exploration, extraction, and commodification create also new territories. Resource scarcity blurs administrative frontiers and existing political and social orders, whereas the territorialization of resource management creates new orders. On a local scale, resource management issues are definitely bounded by a geographical space that foster the emergence of community-based collaborative partnerships among individuals with different, if not opposing perspectives (Cheng et al., 2003).

In this article, we address the territorial embeddedness of resource management: the way in which resource management is shaped by the territorial context in which it occurs, as well as the way in which resource management contribute to shape new territories. However, the connections between territory and resource management appear

difficult to define uniformly since they are deeply context-dependent, varying across spaces and over time, depending on strategies of resource optimization.

To enhance knowledge about territorial embeddedness of natural resource management, we explore the territorialization processes engendered by a specific natural resource management approach, the implementation of Industrial Ecology (IE). IE seeks to optimize resource management by developing interactions between various stakeholders occupying a common geographic area. The core of IE is understanding the structure and functioning of the industrial, urban or societal metabolism through Material Flow Analysis (MFA) that quantifies inputs, outputs, and stocks for a given system (Brigezu and Moriguchi, 2002). Industrial symbiosis, as a way to implement IE, has been defined as engaging traditionally separate industries in a collective approach to gain competitive advantage through the physical exchange of materials, energy, water and by-products. Physical exchanges can occur within a facility, firm, or organization; between firms co-located in a defined eco-industrial park; between local firms that are not located in the same park; and between firms organized “virtually” across a broader region (Chertov, 2000). We argue that IE can be used to gain new perspectives

* Corresponding author.

E-mail addresses: Juliette.cerceau@gmail.com (J. Cerceau), Nicolas.mat.eit@gmail.com (N. Mat), Guillaume.junqua@mines-alès.fr (G. Junqua).

on territorial patterns emerging with resource optimization. For Chertow (2000), the key to industrial symbiosis are collaboration and the synergistic possibilities offered by geographic proximity. For Beaurain and Brullot (2011), as long as IE fosters material or immaterial interactions among stakeholders within a common spatial area, IE should be considered as a local planning strategy. Through resource optimization, IE contributes to the building of a productive territory aiming at reinforcing the sustainability of production processes.

Firstly, we lay down a theoretical framework that should underlie the use of territory, as a concept, building bridges between geography and IE. Secondly, drawing upon this theoretical framework, we develop a methodological structure that can lead to and manifest the process of territorial construction at work in resource management, and IE in particular. Thirdly, we test the knowledge production capacity of this theoretical and methodological approach to territory in IE by applying it to a specific case study in the South of France: the territorialization of IE in the Aix-Marseille Provence metropolitan area. We finally put our conclusions in perspective with the territorial embeddedness of resource management.

2. Theoretical framework: territories in IE

Territory is not a stand-alone issue for the IE scientific community. For most of the IE scientific community, geographic issues are reduced to the question of system boundaries (O'Rourke et al., 1996; Spiegelman, 2003; Baas and Boons, 2004). Eco-Industrial Parks, involving geographic concentrations of firms and synergies between facilities, constitute a deliberate attempt to apply the principle of IE in a specific and closed location (Gibbs and Deutz, 2005). Once the system boundaries are set, it becomes difficult to observe what happens beyond the system. However, resource issues cross boundaries: for Bergmann and Holmberg (2016), globalization links human consumption to distant land use mediated by commodity chains and capital. Newell and Vos (2011) highlight the challenges of calculating a local carbon footprint while the complexity of scale is largely a function of the number of actors and geographies involved in globalized commodity and energy networks. At local scale, Guibrinet et al. (2017) demonstrate how waste flows trespass both institutional and geographical boundaries, resulting in interconnected layers of urban infrastructure, services and land use. Cerceau et al. (2014) question the notion of proximity in IE, suggesting that it must be adapted by considering the degree of natural, logistical and infrastructural connectivity between nodes of the IE network. IE would thus take place in “regions” considered as a series of open, discontinuous spaces consisting of the social and physical interactions which stretch across them (Allen and Cochrane, 2007). Do these observations suggest that IE implementation contributes to build territory as the effect of networked relations (Painter, 2008)? Are these relations physical, economic, social, or natural? Do they contribute to shape new territories for local actors? Indeed, these discussions on IE system boundaries and proximity hide the urgent need for a conceptual debate on the underlying definition of territory in IE. It appears necessary to challenge the conceptualization of the territorial system in IE, examining territorialization processes engendered by resource exchanges.

This conceptual debate meets political issues. Beyond the material and physical issues linked with the implementation of industrial symbioses, IE is now being discussed as a political issue linked with economic development, resource management, and land planning. IE, as a public policy, is no exception to the general European movement toward a territorialization of public action (Faure, 2012). In IE, this trend has been crystallized in the exponential, systematic use of a territorial semantic: IE is considered as a “collective territorial action” addressing issues of “territorial governance” (Brullot et al., 2014). It is understood as a “process of territorial development” (Beaurain and Brullot, 2011), as a factor of “territorial competitiveness” through the integration of “territorial resources” in industrial processes (Allais et al., 2015). In

France, this shift has been sealed by the semantic evolution from “industrial ecology” to “industrial and territorial ecology”. For Brullot et al. (2014), the addition of “territorial” to “industrial ecology” highlights the reference to a plurality of actors, spaces and issues, and assumes the local relevance of implementing IE. We can thus question the capacity of this territorial semantic to act as a self-fulfilling prophecy: does the announcement of the territorialization of IE suffice to give IE a territorial dimension?

Recognizing (implicitly or explicitly) the territorial dimension of IE is a first step toward the territorialization of IE. To go further, this article challenges the conceptualization of territory as a “black box” in IE, looking instead at the territorial building processes embedded in IE implementation. The objective here is to use geography’s specific perspective to uncover the hidden territorial building processes embedded in IE literature. We thus hypothesize that some geographical debates on territory can be found in IE’s underlying conceptions of territory.

2.1. Determinist versus non-determinist conceptions

It is interesting to think about the underlying reasons for the relative neglect of the concept of territory in IE. It may be plausible to suggest that the concept of territory constitutes a source of embarrassment for the IE community as it recalls the painful though seminal debates on the so-called biological analogy. Indeed, though IE offers an original way of looking at economic activities, based on an analogy between the science of ecology (ecosystems, metabolisms, symbiosis, etc.) and industrial systems, this analogical relationship raises considerable difficulties due to the variety of interpretation it allows (Hess, 2010). In parallel, for Painter (2008) the concept of territory has been uncomfortable for some geographers because of its ill-defined but powerful associations with animal territories in ethology and sociobiology. Any intrusion of sociobiological assumptions within studies on human activities is subject to significant criticism, beginning with suspicions of environmental determinism.

We can establish a parallel with the two opposite understandings of the biological analogy that can be found in the IE literature:

- On the one hand, a *determinist approach* considering that man is submitted to biological and physical laws: human beings must be considered as one biological species among others. There is no discontinuity or alterity from nature (Bourg, 2001). Close to human ecology, IE is an attempt to apply to interrelations between human beings, a type of analysis previously applied to interrelations of plants and animals (Park, 1936; Boons, 2009). The analogy must then be applied literally (Jensen et al., 2011) and ecological concepts are directly transferred from biological systems to anthropogenic systems. For instance, Ehrenfeld (2000) uses the ecological notions of connectivity, community and cooperation; Korhonen (2001) involves the biological concepts of circularity, diversity and proximity. Finally, if anthropogenic systems follow the same rules as biological systems, IE cannot be ordered but occurs spontaneously (Chertow, 2000) during the processes of complexification inherent to the evolution of anthropogenic systems.
- On the other hand, a *non-determinist approach* considering that man is fundamentally different and disconnected from other biological species. Bey (2001, 2005) makes a list of these fundamental differences; no natural equivalence for productive labor, incapacity of anthropogenic systems to recycle waste totally, no natural use of fossil fuel energy, etc. For Isenmann (2003), this philosophical bias implies that human beings impose their rules upon nature: man creates the laws of change and permanence (Ehrenfeld, 2003). Hess (2010) alerted the IE community on the dangers of taking the biological metaphor for a model. McManus and Gibbs (2008) highlighted how IE tropes (i.e. turns of phrase used to embellish an expression) introduce significant bias in the way we understand the world. Therefore, the notion of ecosystem is an analogy that should

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