

Chapter 14

Flow/Fund Theory and Rural Livelihoods



Jose Carlos Silva-Macher

14.1 Introduction

Studies on the relationships between social metabolism and socio-environmental conflicts, or, more accurately, ecological distribution conflicts, are a central theme in the work of Professor Joan Martínez-Alier and the Barcelona School, where the fields of ecological economics and political ecology are united with the other environmental social sciences (Martínez-Alier, 2019; Martínez-Alier & Silva-Macher, 2021): namely, environmental history, industrial ecology, urban ecology, agroecology, and ethnoecology. Of special interest is the study of the metabolism of industrial society at the global level, as well as ecological distribution conflicts (Martínez-Alier et al., 2010; Muradian et al., 2012; Martínez-Alier, 2020) at the frontiers of raw material extraction (Moore, 2000) where different rural societies live – among which *campesinos* and indigenous peoples stand out for their historical, cultural, and political importance. As a frame of reference, these studies can utilize, first, a more biophysical/ecological dimension expressed through the concept of the Anthropocene (Steffen et al., 2011), the age in which changes in human activity created transformations on planet Earth, which hastened greatly after World War II. And, second, they can draw on a more institutional/cultural dimension expressed through the evolution of a modern expression of capitalist colonial power that began with the creation of the Americas (Quijano, 2014; Neyra-Souplet, 2019), whose components include racial discrimination as a basic expression of colonial domination, an economy articulated around capital and the world market, and a colonization of imaginaries and subjectivities regarding a hegemonic perspective of western knowledge.

J. C. Silva-Macher (✉)

Department of Economics, Pontificia Universidad Católica del Perú, Lima, Peru

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Based on this frame of reference, in the present chapter, I seek to describe this relationship between social metabolism and conflicts by drawing on Georgescu-Roegen's (1971) flow/fund theory, one of the fundamentals of ecological economics. The core idea in this chapter was the focus of two published scientific articles that I co-wrote with Katharine N. Farrell as part of my doctoral thesis (Silva-Macher & Farrell, 2014; Farrell & Silva-Macher, 2017), applied to case studies about extraction frontiers in the Peruvian Andes and Amazonia. This idea stems from flow/fund theory and the subsequent proposal of Farrell and Mayumi (2009) and posits that to better understand an economic process one must first comprehend the economic *Anschauung*,¹ the underlying intuition or perspective of intentionality (Farrell, 2021), which means exploring the economic purpose of the *social actor* associated with this specified economic process. According to this conceptualization, in the case of ecological distribution conflicts – such as those that unfold between multinational mining companies and *campesinos* at the metal extraction frontiers of the Peruvian Andes – what emerges are opposite visualizations and perspectives about the territory in dispute.

The rest of the chapter is structured as follows: First, I describe Georgescu-Roegen's flow/fund theory, placing an emphasis on the relationship between economic process and purpose; second, using the language of flows and funds, I present the case of the Conga conflict, an emblematic example of the environmentalism of the poor (Martínez-Alier, 2002) in which *campesinos* resist and defend the life of *Pachamama* against a mining company that seeks to extract gold and copper with the support of the Peruvian government. I take into account the experience of a recent field visit to the home of Máxima Acuña, a *campesina* leader who lives in the place where Yanacocha is looking to establish an open pit. Finally, I conclude the chapter with some brief reflections, pondering on the realities of raw-material exporting countries since colonial times and, in particular, on *campesinos* and indigenous peoples in extraction frontiers.

14.2 The Flow/Fund Theory and the Tree Metaphor

A central theme in the debate between the ecological vision of the economy and the neoclassical vision of the economy (Cavalcanti, 2018) is the operational meaning of substitution in the production function (Mayumi et al. 1998). The neoclassical production functions assume that any factor can be substituted with another, with some exceptions, and therefore that an increase in the input of any factor always means a rise in production. However, as Mayumi et al. (1998) observe, “those neoclassical economists adopting the substitution assumption have not paid due attention to the essential distinction between flows (=quantities of materials qualitatively transformed in the process) and funds (=agents transforming a given set of inflows

¹ Georgescu-Roegen (1971: 362).

into a given set of outflows) in the material production process (Georgescu-Roegen, 1971: 115)". For example, to increase the production of fresh milk (*outflow*), having more fodder (*inflow*) counts for nothing if the number of cattle (*fund*) is the limiting factor or, conversely, if the bottleneck lies in the supply of fodder. This is to pay due attention to the biophysical foundation of economic activities – that is, the *real–real economy* of ecological economists (Martinez-Alier, 2008).

However, before describing a material production process using the flow/fund theory, it is necessary to first define the parameters of the process, which have two analytical components. The first is the *frontier* – which establishes the process vis-à-vis its environment at any moment (the process/non-process distinction). This is not the same as a geographical frontier, in that it entails the mental construction of a partial process that can hardly be said to be enclosed in a defined space. The second component is the *duration* – the points at which the process in question begins and ends, and which show the passage of time through our consciousness.² This is the component that defines the identity of an element, as *flow* or *fund*, in the analytical representation of a material economic process. Finally, the frontier and duration of the process depend on the *Anschaung*, or the perspective of intentionality, which shapes how the specific purpose of a given economic process is defined. That is, they depend on a primary notion that can be clarified by way of discussion and examples, but cannot be reduced by way of a formal definition (Georgescu-Roegen, 1971). These points are stressed by Farrell and Mayumi (2009) in their argument that the general theory of flows and funds is designed to be used based on a consideration of how the parameters of a given process are determined, and of the fact that these parameters are strongly related to time and tradition.

To illustrate this idea, it is worth thinking about the metaphor of a tree and how it is observed by two social actors: a carpenter and a farmer (Silva-Macher & Farrell, 2014). For the carpenter, the tree is a source of wood since its economic purpose is the production of furniture, and to this end it is necessary to cut down the tree, transforming it in a process that can take some hours. On the other hand, for the farmer, the tree is a source of food, since its economic purpose is the gathering of fruit, and to this end it is necessary to sustain and protect the life of the tree, conserving it in a process that can take many years. Therefore, the tree is a *flow* in the carpenter's process but a *fund* in the farmer's process. This situation also relates to a typical socio-environmental conflict in which a single natural resource has two mutually exclusive purposes that, in the language of flows and funds, would represent a dispute over the identity of the tree (Silva-Macher & Farrell, 2014). In the case of an ecological distribution conflict between a mining company and a farming community in the Andes, the focus of the dispute would be the identity of a *mountain*, which depends on the *Anschaung*, or perspective of intentionality (Farrell, 2021;

²"Let $E(T_1)$ and $E(T_2)$ be the entropies of the universe at two different moments in Time, T_1 and T_2 respectively; if $E(T_1) < E(T_2)$, then T_2 is later in Time than T_1 – and conversely. But, clearly, if we did not know already what later means, the statement would be vacuous. The full meaning of the law is that the entropy of the universe increases as Time flows through the observer's consciousness" (Georgescu-Roegen, 1971: 133).

Farrell & Mayumi, 2009), that characterizes each social actor, while also taking into account a long history of power relations in which certain perspectives are imposed on other ones. It is at this level of analysis that ecological economics and political ecology are united in pursuit of environmental justice. The fundamental question that Martínez-Alier (2002: 271) poses is: “Who has the power to simplify complexity, ruling some languages of valuation out of order?”

14.3 A Dispute over the Identity of the *Mountain*

The Andes has historically been a mineral extraction frontier for the world economy, dating back to colonial times in the case of gold and silver, to which copper, zinc, lead, lithium, and others have more recently been added. Peru witnessed a pronounced expansion of this extraction frontier from the 1990s as a result of the country’s Washington Consensus-inspired neoliberal reforms, to which the indicators of domestic extraction clearly attest in the material flow accounts (Russi et al., 2008). Moreover, the vast majority of the metals extracted and concentrated are exported to the world’s industrial centres, such as China, while the tailings and other hazardous waste materials remain in the Andes as environmental liabilities, with severe repercussions for the health and livelihoods of local communities. This results in an ecologically unequal trade that characterizes the pattern of metabolism in industrial society and is reflected in the profound inequalities within raw-material exporting countries (Pérez-Rincón et al., 2019; Infante-Amate et al., 2020).

In this context, the Conga gold and copper mining project in Peru is an emblematic conflict between a multinational mining company and campesinos in the Andes (Silva-Macher & Farrell, 2014). The mining company is Yanacocha, a joint venture between Newmont Corporation (51.35%), based in the United States; Compañía de Minas Buenaventura (43.65%), based in Peru; and Sumitomo Corporation (5%), based in Japan. Campesinos are made up of small-scale farmers who live around the headwaters of the Cajamarca region, which flow into the Marañón River and, from there, into the Amazon. The landscape is typically Andean and includes lakes, natural pasture, potatoes and other crops, livestock such as horses, cattle, sheep, and guinea pigs, adobe houses, and improved unpaved roads, juxtaposed with trucks, metal fencing, gates restricting access along rural tracks, CCTV cameras, and other installations put in place by Yanacocha.

For an analytical representation with which to describe the economic purposes and processes in dispute, and thus to better understand the anatomy of the Conga conflict, the flow/fund theory is useful (Silva-Macher & Farrell, 2014). This entails an exploration of the gold and copper extraction process carried out by the Yanacocha mining company, and the fresh milk production process of the Cajamarca campesinos. On the one hand, there is the economic *Anschaung* of a multinational corporation oriented toward the maximization of private gain, which regards the *mountain* as a potential source of income through the sale of minerals to the world market. The problem is that, to realize this economic purpose, the company must extract and

concentrate the gold and copper, for which it inevitably transforms the Andean landscape – over a period of some 20 years – through blasts, excavations, and mineral crushing and concentration processes that are intensive in the use of water, energy, and chemical products, leaving large open pits in the land and generating an equivalent proportion of waste. This alteration of the mountain ecosystem integrity implies the disappearance of lakes, pastures, crops, animals, and campesinos' homes. Therefore, the *mountain* would be an *inflow* from the perspective of the Yanacocha mining company, transformed into two types of *outflow*: on the one hand, the product, represented by gold and copper for export; and on the other, the waste and the devastated Andean landscape, whose social and environmental costs are transferred to the campesinos of Cajamarca, bolstering the profits of the mining corporation all the more.

In this context, there is particular interest in the land and house of Máxima Acuña, an activist and recipient of the Goldman Environmental Prize who lives in the very place earmarked for one of the open pits of the Conga project – in Tragadero Grande and the Laguna Azul³ – whose case undoubtedly expresses the mutually exclusive purposes of agriculture and mining. During a field visit in March 2020 to Máxima Acuña's home – which, given the overlap, is also a visit to the Conga project concession area – I had the opportunity to accompany Ms. Acuña's son Daniel Chaupe, a young campesino who lives in the same house, on his daily work routine. This brought me closer to the economic *Anschaung*, or perspective, of a campesino family in relation to the *mountain* landscape⁴ whose identity is in dispute. Through this lens, the *mountain* is observed as a source of life given that its purpose is associated with *buen vivir* in the Andes, which implies growing crops, rearing animals, spending time with one's family, and maintaining strong social relations, among other aspects that I was unable to measure entirely through observation. It should be noted that there is no mathematical model with which to describe this immaterial flow for the enjoyment of life, or *buen vivir*, associated with economic activity (Georgescu-Roegen, 1971; Cavalcanti, 2018). However, what can be affirmed is that, to carry out agricultural economic processes, it is necessary to conserve the integrity of the *mountain* for several generations. In this regard, the fresh milk production process, which is a simple sign of campesino life in the vicinity of the Conga project, requires that the cattle have access to sufficient flows of water and pasture, which are natural products of the mountain. Therefore, the mountain has the identity of a *fund* element from the perspective of the Acuñas and other campesino families. It is notable that this same *fund* can provide multiple services for different economic processes and for human activities in a broader sense, as part of the campesino life; studies on the multifunctionality of agriculture and rural livelihoods are of relevance here.

This perspective could be validated by other, the local inhabitants, most of them also campesinos, in the area of influence of the Conga project – perhaps by way of

³<https://photos.app.goo.gl/s5aqYoY9esN5DC499>

⁴Tragadero Grande: Cerro del Águila, Cerro Colorado, and Laguna Azul.

a popular referendum (Conde, 2017; Urkidi & Walter, 2011; Bebbington & Williams, 2008; Muradian et al., 2003). However, a similar viewpoint can be discerned from the testimonies of other female campesino leaders in Peru, who face similar conflicts. Two of them, Yanet Caruajulca and Zulma Zamora, told their stories during the “Territorial Struggles for Women’s Socio-Environmental Justice in the face of Extractivism” panel, as part of the Second Congress of the Andean Region Society for Ecological Economics,⁵ held at the Pontificia Universidad Católica del Perú in April 2019. This campesino perspective was also glimpsed through Yanet Caruajulca’s presentation during the “Indigenous and Black Communities and the Impact of Covid-19” session, as part of the *Global On-line Symposium of the International Degrowth Network and the International Society for Ecological Economics*,⁶ University of Manchester, in early September 2020. To borrow one of the slogans from the protests against mining in the Andes, one might recapitulate that, for life, *el agua vale más que el oro* (water is worth more than gold).

14.4 Final Reflections

The ecological vision of economics means recognizing the biophysical reality of economic processes, but this is not the only element to be observed. The flow/fund theory of Georgescu-Roegen shows us that to better understand a given economic process, we must first understand the underlying purpose. This, in turn, means exploring the *Anschauung*, or perspective of intentionality, of the social actor linked to a certain partial economic process. In this regard, the flow/fund theory can serve as a useful tool for studying the relationship between social metabolism and ecological distribution conflicts.

To prevent socio-environmental conflicts between mining and agriculture, adequate land-use planning is recommendable. Any such public policy would have to pay due attention to the different perspectives and perceptions present in a territory, which could be in conflict or, in the best-case scenario, in harmony. In the case of the Conga conflict, in which the extraction of gold and copper and the production of fresh milk dispute the identity of a mountain, in terms of *flow* and *fund*, the conflict could have been predicted in advance. For reasons of ethics and the long-term sustainability of the socio-ecological system, those perspectives that assert respect for life, fair distribution, and ecosystem integrity have to be prioritized.

However, history since colonial times has shown us that the languages of valuation respond to power relations and are often imposed through the exercise of violence. In the case of Conga, despite the campesino resistance, which has kept the project on hold to this day, five local inhabitants died during protests against the

⁵ https://educast.pucp.edu.pe/video/11244/ii_congreso_de_la_sociedad_andina_de_economia_ecologica__parte_12

⁶ <http://www.conferece.manchester.ac.uk/events/degrowth2020/>

mine in 2012. Mining companies, the Peruvian government, and economic elites use the arguments of economic growth and development to justify this type of extractive project, which gives us pause to reflect on the relevance of discourses of transition and post-development, such as those of degrowth in Europe and *buen vivir* in South America, to offer new narratives that place care and respect for life at the heart of the debate.

References

- Bebbington, A., & Williams, M. (2008). Water and mining conflicts in Peru. *Mountain Research and Development*, 28(3/4), 190–195.
- Cavalcanti, C. (2018). De la economía convencional a la economía ecológica: el significado de Nicholas Georgescu-Roegen y la encíclica Laudato Si' del Papa Francisco. *Gestión y Ambiente*, 21(supl. 1), 49–56.
- Conde, M. (2017). Resistance to mining: A review. *Ecological Economics*, 132, 80–90.
- Farrell, K. N. (2021). Mejorar la vida ecológica, mejora la vida económica. In A. Rincón-Ruiz, P. Arias-Arévalo, & M. Clavijo-Romero (Eds.), *Hacia una valoración incluyente y plural de la biodiversidad y los servicios ecosistémicos: visiones, avances y retos en América Latina*. Centro Editorial – Facultad de Ciencias Económicas, Universidad Nacional de Colombia.
- Farrell, K. N., & Mayumi, K. (2009). Time horizons and electricity futures: An application of Nicholas Georgescu-Roegen's general theory of economic production. *Energy*, 34, 301–307.
- Farrell, K. N., & Silva-Macher, J. C. (2017). Exploring futures for Amazonia's Sierra del Divisor: An environmental valuation triadics approach to analyzing ecological economic decision choices in the context of major shifts in boundary conditions. *Ecological Economics*, 141, 166–179.
- Georgescu-Roegen, N. (1971). *The entropy law and the economic process*. Harvard University Press.
- Infante-Amate, J., Urrego, A., & Tello, E. (2020). Las venas abiertas de América Latina en la era del Antropoceno: un estudio biofísico del comercio exterior (1900–2016). *Diálogos Revista Electrónica de Historia*, 21(2), 177–214.
- Martínez-Alier, J. (2002). *The environmentalism of the poor: A study of ecological conflicts and valuation*. Edward Edgar Publishing.
- Martínez-Alier, J. (2008). La crisis económica vista desde la economía ecológica. *Ecología Política*, 36, 23–32.
- Martínez-Alier, J. (2019). La enseñanza de las ciencias socioambientales. *Observatorio del Desarrollo: investigación, reflexión y análisis*, 8(22), 29–36.
- Martínez-Alier, J. (2020). A global environmental justice movement: Mapping ecological distribution conflicts. *Disjuntiva*, 1(2), 83–128.
- Martínez-Alier, J., & Silva-Macher, J. C. (2021). Las ciencias socio-ambientales. In Azamar, Silva-Macher, & Zuberman (Eds.), *Una mirada desde la economía ecológica Latinoamericana frente a la crisis socioecológica*. CLACSO y Siglo XXI.
- Martínez-Alier, J., Kallis, G., Veuthey, S., Walter, M., & Temper, L. (2010). Introduction: Social metabolism, ecological distribution conflicts, and valuation languages. *Ecological Economics*, 70, 153–158.
- Mayumi, K., Giampietro, M., & Gowdy, J. (1998). Georgescu-Roegen/Daly versus Solow/Stiglitz revisited. *Ecological Economics*, 27, 115–117.
- Moore, J. W. (2000). Sugar and the expansion of the early modern world-economy: Commodity frontiers, ecological transformation, and industrialization. *Review*, 23(3), 409–433.
- Muradian, R., Martínez-Alier, J., & Correa, H. (2003). International capital versus local population: The environmental conflict of the Tambogrande mining project, Peru. *Society & Natural Resources: An International Journal*, 16(9), 775–792.

- Muradian, R., Walter, M., & Martinez-Alier, J. (2012). Hegemonic transitions and global shifts in social metabolism: Implications for resource-rich countries, Introduction to the special section, global environmental change part A. *Human and Policy Dimensions*, 22(3), 559–567.
- Neyra-Souplet, R. (2019). Violencia y Extractivismo en el Perú contemporáneo. *Historia Ambiental Latinoamericana y Caribeña (HALAC) Revista de la Solcha*, 9(2), 210–236.
- Pérez-Rincón, M., Vargas-Morales, J., & Martinez-Alier, J. (2019). Mapping and analyzing ecological distribution conflicts in Andean countries. *Ecological Economics*, 157, 80–91.
- Quijano, A. (2014). Colonialidad del poder, eurocentrismo y América Latina. In *Cuestiones y horizontes: de la dependencia histórico-estructural a la colonialidad/descolonialidad del poder*. CLACSO.
- Russi, D., González-Martínez, A. C., Silva-Macher, J. C., Giljum, S., Martínez-Alier, J., & Vallejo, M. C. (2008). Material flows in Latin America: A comparative analysis of Chile, Ecuador, Mexico, and Peru, 1980–2000. *Journal of Industrial Ecology*, 12(5/6), 704–720.
- Silva-Macher, J. C., & Farrell, K. N. (2014). The flow/fund model of Conga: Exploring the anatomy of environmental conflicts at the Andes-Amazon commodity frontier. *Environment, Development and Sustainability*, 16, 747–768.
- Steffen, W., Grinevald, J., Crutzen, P., & McNeill, J. (2011). The Anthropocene: Conceptual and historical perspectives. *Philosophical Transactions of the Royal Society A*, 369, 842–867.
- Urkidi, L., & Walter, M. (2011). Dimensions of environmental justice in anti-gold mining movements in Latin America. *Geoforum*, 42(6), 683–695.

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