Part I
Setting the Stage

1
Origins and Perspectives of Latin American Environmentalism

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Introduction

The debate on the socioenvironmental challenges faced by Latin America has a long history. This history is crucial to understanding Latin American perspectives on environmental governance and, above all, to understanding the specific characteristics which determine these perspectives. Traditional debates on environmental governance tend to see the Western debates on nature and environment as determining views and perspectives on a global scale. The suggestion is that Latin American environmental debates were directed by the changing views in the industrialized world. This chapter, however, suggests that Latin America has developed its own strands and perspectives on environmental issues which were emerging from its peculiar historical position. A focus on the specific, and to a large extent autonomous, knowledge development on nature and environment allow us to understand the determining roots of Latin American ideas on environmental governance.

Latin American environmental ideas are closely connected to an environmental history since the Spanish Conquest, which was characterized by a dramatic drop in population and a series of export booms driven by one commodity after another. An early case in point may be the exportation of guano from Peru that amounted to about 11 million tons over 40 years, from 1840 to 1880, and was based on the exploitation of indentured Chinese workers (Gootenberg, 1993). In the last decades of the nineteenth century and in the beginning of the twentieth century, the entire Latin American region experienced a dramatic boom in agriculture for exportation. New crops such as coffee, cacao and banana, along with more traditional goods such as sugar, changed the economic and ecological context of much of Latin America as well as the lives of

large sectors of its population. The agrarian frontier expanded, and large territories, often in the interior of the new republics, were deforested and occupied by new forms of agriculture. The expansion of coffee cultivation in Antioquia, Colombia, and of cacao in the interior of Ilhéus in the north-east of Brazil have been iconic examples, just like rubber and henequen in southern and south-eastern Mexico, the banana belt in Central America, Colombia and Ecuador, and the occupation of the Pampas in Argentina and southern Brazil (for a number of examples, see Topic, Marichal and Frank, 2006). Cuban sugar export increased from 1 million tons per year around 1900 to 3 million tons by 1920, causing dramatic deforestation on the island (Funes Monzote, 2004a, 2004b). This sacrifice was unaccounted for in the modernizing ideology of the time, epitomized by Arango Parreño's slogan of 1770, "*sin azúcar no hay país*" ("without sugar, no country") (Moreno Fraginals, 1978).

This expansion of the agrarian frontier was accompanied by ideologies of progress, the incorporation of new business elites, and a strong dependence on the international market. With the Chilean triumph in the Pacific War (1879–1883) and the incorporation of Antofagasta and Tarapacá, Chile became the world's principal producer of the mineral saltpetre. The exportation of this sodium nitrate increased until 1914 and remained constant until the crisis of 1929, oscillating between 1.5 and 3 million tons per year (Miller and Greenhill, 2006). This provoked an economic boom like the country had not experienced before.

In the beginning of the twentieth century, the oil industry in Venezuela and Mexico began to grow, causing ecological and social disasters at a scale unknown at the time (Santiago, 2006). This process continues today: the calculation (in tons) of primary materials that are exported (West and Schandl, 2013) reveals a multiplication of four, from 1970 to 2010.[1] As an example, Venezuela exports roughly 120 million tons of oil per year.

Recently, with the expansion of the Chinese economy, the extraction of natural resources (not only minerals and oil but also agrarian products, such as soy) has grown at an extraordinary rate. The Government of Uruguay is considering exporting 18 million tons of iron ore per year under the Aratirí project. Meanwhile, Chile exports 5 million tons of copper per year, which requires the removal of land, enormous production of slag and a large input of energy. Colombia exports almost 100 million tons of coal per year; Brazil annually exports 400 million tons of soy and iron ore. There are signs that the recent economic bonanza from primary exports is coming to a halt in 2015, reinforcing the critiques from the "post-extractivist" school. However, this might be

only a temporary situation. New supplies of energy and materials from Latin America will find markets, and domestic and foreign demand.

The beginning

The population of the American continent suffered an enormous drop during the Spanish colonization. The population was drastically reduced by the exploitation to which it was subjected, but the "Great Dying", as it was called by Eric Wolf (1982: 133ff), was primarily due to the spread of infectious diseases. From an estimated 140 million people in the year 1500, only 40 million were registered 60 years later (Tudela, 1990; also Sánchez-Albornoz, 1984). The American population, which had a size comparable to that of Europe at the time, dropped some 80%. This historical process is unparalleled in other continents with the exception of Australia and a few other places in the world (e.g. the Canary Islands, Hawaii) that have experienced a similar phenomenon. The decrease in the native population – and its slow substitution by an immigrant population in the neo-European (as they were called by Crosby, 2004) and also later in the humid tropics – should be understood as a biological as well as a military process. The conquistadores arrived in new territories in search of riches. They had little mercy for the native population and, unwittingly but also relentlessly, they contaminated it with new fatal illnesses.

However, the depopulation in the first century after the colonization can not only be attributed to the arrival of Hernán Cortés and Francisco Pizarro and their troops in the former Mexican and Andean empires (or even before they arrived, as death travelled fast). The archaeology of the Amazon today confirms the existence of population densities much greater than those during several centuries following the conquest. There had already been collapses of empires, and perhaps also of populations before the Spanish Conquest, such as in the Mayan territory, but what happened in the American demography after 1492 had no precedent on a continental scale and throughout the history of mankind.

Today's low population density in Latin America (with local exceptions such as El Salvador and Haiti) negates one of the principle arguments in ecological thinking, namely, that population density is the key problem of environmental degradation. Nowhere in Latin America is there an issue of overpopulation as in Europe (with densities of up to 300 people per square kilometre in Germany, Italy and England) or in India and Bangladesh. In Latin America, population increase later

became an explicit policy of modernist governments. In this sense, the famous remark by Argentinian Juan Bautista Alberdi in 1852, "to govern is to populate", is symbolic of the mindset of the Latin American elites of that time. Much later, during the time of the military dictatorship (1964–1986), the Brazilian state – in its geopolitical delirium – called for an increase in birth rate in order to populate the Amazon against foreign threats.

Ecology and demographics thus changed rapidly in the context of early colonization. Under the rule of one single dynasty – the Habsburgs – for the first 200 years, the Spanish American territories saw enormous ecological and demographic changes. Invasive species arrived (Melville, 1999), whereas the expansion of modern mining methods (modern in technology and scale) in regions such as Potosí, Zacatecas and also Minas Gerais led to a great decrease in population and enormous pollution by mercury (Machado Araoz, 2014). In a later stage, the frontiers of silver and gold extraction and – almost always at the same time – of deforestation moved to those of sugarcane in the Caribbean and the north-east of Brazil, and later the regions that produced and exported coffee, rubber, wood such as mahogany and quebracho, meat, banana, soy, copper, oil and coal, iron ore and bauxite (Brannstrom, 2004).

Conservationist environmentalism

Despite the anthropogenic changes that happened before and after 1492, Latin America managed to conserve immense biological diversity in many of its diverse ecosystems. The Amazon had scarcely been touched before the rubber whirlwind at the end of the nineteenth century. This enormous biological richness attracted the attention of European explorers such as Alexander von Humboldt (1769–1859), the renowned Prussian scientist. Without his explorations of this part of the world that came to be known as the "Neotropics", biogeography, the study of the geographical distribution of plants and other life forms, would not have been developed in the same way. His intention, which he never accomplished, was to return to Latin America once it had become independent and to direct an academy with scientific correspondents from Mexico to Patagonia.

On 29 July 1822, when he was in Paris, Humboldt wrote a letter to Simon Bolívar introducing him to the young mining experts, Jean Baptiste Boussingault and Mariano de Rivero. Some years later, in his *Memoria sobre el Guano de los Pájaros* (1827), Mariano de Rivero

remembered how Humboldt had given samples of guano to Fourcroy and Vauquelin who analysed the chemical elements of this fertilizer. Still later, Mariano de Rivero regretted that Peru had not durably invested the revenues from guano exports in a policy that we now call "weak sustainability" (Alcalde Mongrut, 1966). This renewable product was exported at such a rate that it led to its depletion. It should have been invested in businesses that could have generated permanent income. This proposal is similar to that which was later proposed by Uslar Pietri in Venezuela in 1936, baptized as the "sowing of the oil" (*sembrar el petróleo*) (Martínez-Alier and Roca, 2013: 116–117).

Humboldt described the geology, volcanoes, biogeography and the richness of species of the American territories that he visited between 1799 and 1805. Later – and largely due to Darwin – Latin America came to hold a privileged role in the science of biological evolution. Darwin's explanation of the origin of species owes much to his trip to America during the Beagle mission (from 1831 to 1836) to collect materials. He came up with ideas that eventually, after his crucial stay in the Galápagos, led him to express his astonishment at the number of endemic species, given that the islands had only come to exist in a geologically recent period. By observing finches and variations in the size and form of their beaks (which ecotourists continue to discuss today), he concluded that only one race of such birds had arrived and established itself on the archipelago, and that new species had arisen through adaptation to specific food sources.

South America was therefore crucial to the history and evolution of biology as well as the history of agrarian chemistry and the development of the idea of "social metabolism". By 1840, Liebig, Boussingault and other scientists, based on the analysis of Peruvian guano and other fertilizers, determined that plants need three principal nutrients – phosphor, potassium and nitrogen – and that agriculture should evolve from a system of plundering to one of restitution (McCosh, 1984: 81–82). The fertilizing properties of guano were known by the historic inhabitants of Peru but had not been described or analysed in chemical terms. Guano had global importance – it was exported as a fertilizer but also served and strongly influenced the minds of the agrarian chemists (Gootenberg, 1993; Cushman, 2013).

In the course of the nineteenth century, conservationist environmentalism increased. Most intellectuals and politicians lived in parts of Latin American cities which were somewhat removed from the environmental destruction caused by mining and by the agro-export model. Gradually, however, urban populations also started to be confronted by

issues of pollution and environmental destruction in their own habitat. This was most directly the case with dirty water, sanitation and infectious diseases, which alarmed urban elites. The growth of cities also led to environmental destruction and deforestation to which they could not close their eyes. Warren Dean presented some impressive estimates about urban-led deforestation in Brazil. He calculated that a city such as Rio de Janeiro consumed at least 270,000 tons of firewood every year in the 1880s (almost 20% provided by mangroves). For the construction of a small brick house, 37 tons of firewood may have been needed. This would mean that the buildings of the city of Rio de Janeiro by 1890 cost the deforestation of 200 square kilometres (Dean, 1995: 196–197). He may have overstated his case and exaggerated the importance of wood as the principal source of energy for Brazil's urban growth (Brannstrom, 2005), but there is no doubt that the relentless progress promoted by Latin American elites came at the cost of rapid deforestation.

These developments led to a plethora of environmental research. The distinct biomes of the Americas have all had their iconic researchers. The dry tropical forest of the Chaco was studied by the great ecologist Jorge Morello (1932–2013). He sponsored excellent collective research at the University of Buenos Aires, on the Pampas and the Chaco, and also on the coastal areas and the conurbation of Buenos Aires (e.g. Morello and Matteucci, 2000). He occupied the post of director of National Parks for a short time under the government of Raúl Alfonsín. In the ecological and political history of Argentina, the logging of red quebracho for railroad ties and the export of tannin for tanneries (by the British company La Forestal) in Santa Fe and in the Chaco during the first 40 years of the twentieth century played a notable role. In Argentina there has been active conservationism since the end of the nineteenth century, responsible for the creation of various national parks in different ecosystems. The dedication of Maximina Monasterio to the study of the Andean *páramo* has been similar to that of Jorge Morello in the Chaco. Born of a Galician refugee family in Argentina, educated and graduated with a doctorate in ecology in France, with long sojourns in Bolivia and exiled to Venezuela in 1966, she has been a crucial figure in research on and education about the Andean highlands from Venezuela to Ecuador. Monasterio studied, in her own words, "from the *frailejones* to the potatoes" (i.e. both the "wild" and the agricultural biodiversity of the highlands) (Monasterio, 2003). Today the ecosystemic services provided by the *páramos* are common knowledge – as sources of water for the people in the lowlands and their livestock. Thus in Colombia the biodiversity research institute (Instituto de Investigación de Recursos

Biológicos) "Alexander von Humboldt" is currently in charge of delimiting and protecting the *páramo* ecosystems, and in this way of preventing coal mining in such areas.

In Mexico, Arturo Gómez Pompa, a biologist at the National Autonomous University of Mexico (Universidad Nacional Autónoma de México (UNAM)) and of the same generation as Morello and Monasterio, studied the ecology of tropical forests and ethnobotany (see http://www.agomezpompa.org). He was one of the most prominent voices in denouncing deforestation in south-east Mexico. He is also known for having discovered the chocolate tree in the Mayan jungle. The idea of the cultivated jungle (or the "cultured jungle", as Philippe Descola (1986) called the Amazonian Achuar forest) became very important in Latin American conservationism.

Conservationism in Latin American is a consequence of foreign influence but it also has its own local tradition. It uses universal and more or less strict instruments, such as the Constitution of the National Parks, the inclusion of wetlands and marshes in the list of the international Ramsar Convention, and the Biosphere Reserves sponsored by UNESCO. The natural reserves have sometimes been protected by the support of international conservationism. However, many countries rightly stress the importance of their own national scientists and public policy-makers in the designing of conservationist policies. In Peru, the forest engineer Marc Dourojeanni played an important role in establishing protected areas – around 1970 during the administration of Velasco Alvarado – to save both the vicuña in the Andean highlands and the Amazonian forests (Dourojeanni, 1988, 1990). In Mexico the conservation efforts of figures such as Enrique Beltrán and Miguel Angel de Quevedo (Simonian, 1995) are still well remembered 100 years later. In Ecuador, Nicolás Cuví has highlighted the figure of Acosta Solís, botanist and conservationist, with one foot in his country and the other in the USA (Cuví, 2005). The latter's research on the remnants of the quinine tree (the tree that is on the shield of the Republic of Peru) became suddenly relevant by the Second World War when the US troops were fighting in the Pacific tropics and were threatened by malaria.

More than a century ago, part of the Amazon suffered from the onslaught of the rubber boom, which had a significant negative impact on indigenous populations. Another principal threat is perhaps the global climate change that could convert the rainforest into savannah. Meanwhile, the Atlantic Forest in Brazil, the forests of southern Mexico and Central America, like the forests of southern Chile and Argentina,

were largely destroyed in the twentieth century by grazing, agricultural crops and monocultures of trees such as pine and eucalyptus. José Augusto Pádua has explained how the statesman José Bonifacio predicted the destruction of the coastal forests as early as the moment of Brazilian independence. Conservationists such as Alberto Torres (born in 1865 on a plantation in Rio de Janeiro that was already in decline because of soil erosion) also publicly deplored the forest destruction in the march of extractivist civilization towards the interior (Pádua, 2002, 2010; see also Drummond, 1997).

It is noteworthy to mention that, in the conservation movement of 80 years ago, there was already a major controversy. Ciriacy-Wantrup suggested that "conservationism itself may not mean non-use". This Berkeley economist anticipated an economic approach to sustainability. His major book was published in 1952 and its translation (by Edmundo Flores, an agricultural economist), published in Mexico in 1957, had an important impact on the region (Ciriacy-Wantrup, 1957).

In summary, there is a Latin American conservationist tradition with deep historic roots. It found scientific support in the sciences of biogeography and conservation biology, and also, later, in the economics of natural resources and the study of watersheds. Different from the popular environmentalism and the agroecology and post-development movements that we shall analyse below, this conservationist trend has had powerful support in the North, among organizations such as the International Union for Conservation of Nature (IUCN), the WWF and other international institutions, such as the US Resources for the Future, and the Smithsonian.

Agroecology and post-developmentalism

The agroecological pride of the Andean and Mesoamerican regions (with authors such as Chilean Miguel Altieri and Mexican Victor Toledo) (Altieri and Toledo, 2011) has roots that are even older than conservationism, but it did not manifest itself significantly until the 1970s and 1980s. A good example of this new visibility was the Andean Project for Peasant Technologies (PRATEC) in Peru, which was established by dissident agronomists from the school of La Molina. In this school they had learned the technological simplification as the result of the focus on the main export crops, sugar and cotton, that included the elimination of native varieties of coloured cotton. They reacted against this teaching (Proyecto SEINPA, 1990) and were critical of the notion of uniform "development". They were responsible for the first edition in

Spanish in 1996 of *The Development Dictionary* edited by Wolfgang Sachs, a post-developmentalist classic (Sachs, 1981). They began to research and apply the agrarian epistemologies of the indigenous inhabitants of the Sierra, expressed in the conservation and use of many varieties and species of seeds.

Latin American environmentalism is different from that of the USA as it has drawn significantly from ancestral agricultural practices and respect for indigenous knowledge. There is a line from the agroecological studies and practices of the influential agronomist from Chapingo, Efrain Hernández Xolocotzi (1913–1991), whose career (in the USA and in Mexico) culminated in a substantial and competent school of Mexican ethnoecologists, to the peasant movement in Mexico which manifests itself in the twenty-first century under the motto "without maize, no country" (*sin maíz no hay país*) (Esteva and Marielle, 2003). Victor Toledo (*La Jornada*, 5 August 2014) asserts that the indigenous agrarian Mesoamerican civilization survives and persists: "These indigenous populations are the principle opponents to the industrial civilization model." Indigenous agriculture and agroforestry are major sources of Latin America environmentalism.

In order to understand traditional Latin American agricultural systems, it is necessary to enter into a "dialogue of knowledges", if not a rejection of Western thought. The communities whose situation and practices have been studied by anthropologists and agronomists bring to the table their own perspectives and knowledge to guide the research, an idea that Robert Chambers of Sussex University (Chambers, 1983) developed from Paulo Freire and Orlando Fals Borda, important Latin American intellectuals. This dialogue of knowledges is also shared by environmentalists in other contexts, such as in Funtowicz and Ravetz's doctrine of "post-normal science", which supports and even requires an "extended peer review" in situations of technological uncertainty and of urgent decisions (Funtowicz and Ravetz, 2000).

Even more radically, political ecologist Héctor Alimonda explains that environmental degradation is caused by "persistent colonialism". He writes: "Over five centuries, entire ecosystems were destroyed by the implementation of monoculture export crops" (2011: 22). "Colonialism" is also useful for interpreting the environmental crisis in terms of the loss of indigenous knowledge and cultures, true "epistemicides" (Sousa Santos' word) that cannot be compensated by either Western science or by a dialogue of knowledges.

Patterns of economic and environmental sustainability in pre-Hispanic societies, which we know from archaeology or which have

survived with many changes, express the social values of these societies. They are more useful for the period in which we live because they question the illusion of universal, uniformizing development. Arturo Escobar (1995, 2010) and Gustavo Esteva (who met with Ivan Illich in 1983) have been outstanding thinkers in the field of post-developmentalism, previous or parallel to the discussion of degrowth, *décroissance* or "prosperity without growth" in Europe.[2] They have deep roots in the Latin American mindset (or *Abya-Yala*, as it is sometimes called) but they also find inspiration in Ivan Illich, Cornelius Castoriadis and André Gorz, political ecologists of the 1970s, and in authors from India, such as Ashish Nandy and Shiv Visvanathan.

In Ecuador, the political debate after 2007 has introduced the concept of Sumak Kawsay, *Buen Vivir*, possibly after many hundreds or thousands of years of verbal usage. Since the year 2000, the concept has been revisited in articles and theses by Quechua intellectuals such as Carlos Eloy Viteri. Viteri comes from the Amazonian village of Sarayaku, which prevented a local oil-extraction project, and his ideas have been heavily influenced by this situation. Sumak Kawsay was converted into a national objective included in the Ecuadorian constitution of 2008, introduced under the presidency of Alberto Acosta in the constituent assembly (Hidalgo-Capitán et al., 2014).

Beyond disputes over the merits of these constitutional developments, the fact is that putting Sumak Kawsay central is very different from saying that the main objective being pursued is economic growth or even sustainable development. Sumak Kawsay is something similar to a solidary and ecological economy, which had already existed and needed to be recovered. It is a concept related to "post-developmentalism".

Governments and international organizations: "Our own agenda"

Since the last decades of the nineteenth century, there have been voices of scientists as well as writers criticizing the indiscriminate use of natural resources, but they were never heard amid the obsession with the modernity of the time (Baud, 2013). In the second half of the twentieth century, the critique became more coherent and politically articulate. Although it occurred in the context of a global debate, it showed a markedly Latin American perspective and influenced the creation of what is now called an "environmental institutionalism" with new ministries, laws and regulations. Since Rachel Carson published *The Silent Spring* in 1962, and especially since the Meadows Report to the Club of

Rome in 1972, international environmentalism has taken off. At first this debate was scarcely considered by Latin American governments or by the Economic Commission for Latin America and the Caribbean (Comisión Económica para América Latina y el Caribe (ECLAC/CEPAL)). For them the problem of underdevelopment and poverty was the bigger issue, and their main objective was to augment the productive capacity of the region and to consolidate its economic expansion. Nevertheless, in those decades, all national governments created legal and administrative structures for natural resource management. It is important to note the creation of the United Nations Environment Programme (UNEP) at a worldwide level and furthermore the active participation of the Regional Office for Latin America and the Caribbean, which from 1975 onwards promoted courses and debates in all Latin American countries, effectively training university professors, NGOs, and personnel from natural resources and environment administrations.

With the support of UNEP, the Spanish Iniciativa de Copenhague para Centroamérica y México (CIFCA) was created and a multitude of courses and seminars were organized in Latin America and Europe. In 1980 the Latin American governments and universities decided to create their own Environmental Education Network. The Argentinian economist Héctor Sejenovich and the Colombian philosopher Augusto Angel Maya elaborated a plan for training and research. All countries had an office from the Environmental Education Network (Red de Formación Ambiental), in large part with governmental organizations but also with NGOs. In Europe a debate was initiated by Sicco Mansholt, president of the European Commission, who converted to the "growth below zero" doctrine upon reading the Meadows Report. This European debate, which involved the participation of André Gorz, Edgar Morin, Herbert Marcuse and other early ecological thinkers, was published in Santiago de Chile in 1972 and in Buenos Aires in 1975 with the spectacular title *Ecology and Revolution* (Marcuse, 1975). However, the book does not seem to have been influential, perhaps because of Latin America's military-led neoliberal backlash at the time.

In fact, the first articulated response to the environmental problems in Latin America came in the 1970s from the Bariloche Foundation in Argentina which in 1976 published the report *Catastrophe or New Society? Latin American World Model* (Herrera et al., 1976). In this report, various specialists such as Gilberto Gallopin developed a new environmental model for Latin America, in which the idea of the scarcity of natural resources was basically rejected. Gudynas (1999: 110) observes that these ideas were considered a direct attack on the idea of development

and progress for Latin America. As a logical consequence, the reaction to the Meadows Report was negative, as is evident in the writings of Amilcar Herrera and Helio Jaguaribe (1973; see also Estenssoro Saavedra, 2014, cap. 7). The general conviction was that Latin American natural resources were abundant and that it was necessary to exploit them in order to develop the region. The Bariloche group emphasized two issues: the low population density of Latin America and its enormous and unknown ecological potentials. Latin American diplomats started to reject notions of "limits to growth" and believed that Latin America could resolve its problems of poverty and development, and at the same time achieve a more sustainable model, drawing also on the world's solidarity. This line of thought was very clear in Brazil, where the national ideology focused on the Amazon (Garfield, 2013). Before the Stockholm Conference of 1972, João Augusto de Araujo Castro, Brazilian diplomat of the United Nations, had asked for "a worldwide compromise on development" from and towards the poor countries. He talked of "a contamination of opulence and a contamination of poverty" (Estenssoro Saavedra, 2014: 129).

Since the mid-1970s, under the influence of Ignacy Sachs (who was a university professor in Paris and travelled to Mexico and Brazil), the notion of "ecodevelopment" spread (e.g. Sachs, 1981, 2008), long before sustainable development would triumph in the rhetoric of the Brundtland Report of 1987. Various Latin American authors, from within official organisms or as consultants or university professors, and people involved in activism – including Enrique Leff, Vicente Sánchez, Victor Toledo and Augusto Angel Maya – were inspired by the idea of ecodevelopment. As part of the actions of UNEP, and along with the participation of the University of Tehran (under the direction of Mohammad Taghi Fharyar), a network of ecodevelopment projects was established. In 1976 the first Symposium on Ecodevelopment was hosted at UNAM, organized by Enrique Leff.

In October 1974, UNEP organized a famous conference in Cocoyoc, Mexico. It was here that the so-called Charter of Obligations and Rights of the States was proclaimed. Above all else, Article 30 about environmental governance was important: "The protection, the preservation and the betterment of the environment for current and future generations is the responsibility of all States. They should try to establish their own environmental and development policies in accordance with this responsibility. The environmental policies of all States should promote and not adversely affect the current and future potential of development of developing countries."

In the 1970s and 1980s, ministries of the environment were created in various countries. The influence of UNESCO's Man and Biosphere (MAB) programme was evident, generating new interdisciplinary activity. An example is the reference to urban ecology and human settlements by Martha Schteingart at the Colegio de México (Schteingart y Graizbord, 1998). In economic management, Héctor Sejenovich proposed that to minimize degradation and waste it is necessary to take all costs into account, including those of the reproduction of nature (research, regeneration, control and management), and also all the potential benefits, for an integrated management of resources or, rather, an integrated management of the natural patrimony. The Latin American Council of Social Sciences (El Consejo Latinoamericano de Ciencias Sociales (CLACSO)) formed a working group on environment and development in 1978, led by Sejenovich (Estenssoro Saavedra, 2014, cap. 8). In Colombia, in the National Institute of Renewable Natural Resources and Environment (Instituto Nacional de los Recursos Naturales Renovables y del Ambiente (INDERENA)), Julio Carrizosa and Margarita Merino de Botero (who would later represent South America in the Brundtland Commission) began to take action. No less important was Anibal Patiño, whose early work addressed environmental problems in the Cauca Valley in Colombia (Patiño, 1991).

Environmental issues arrived at CEPAL in the form of a book edited by Osvaldo Sunkel and Nicolo Gligo, *Estilos de desarrollo y medio ambiente en la América Latina* (1981), published after developing activities for more than one year along with the UNEP Regional Office. They emphasized the notion of the ecosystem, the understanding that all of us are part of the same ecosystem and that there is a direct relationship between that which happens in society and in nature (Sunkel and Gligo, 1981). In his contribution to the book, Raúl Prebisch (who, as an economist, had been oblivious to environmental issues during his long and brilliant career) observed from the periphery that "the environmental crisis was generated by the centre's irrational capitalist development model". He also mentioned the danger of excessive carbon dioxide emissions from rich countries. However, the book found little response within CEPAL, despite the efforts of Axel Dourojeanni and Nicolo Gligo himself. CEPAL has not been a leader of environmental thought in Latin America. Nowadays the economic crisis of "extractivism" (the rapidly deteriorating terms of trade in 2014–2015, partly because of excessive global investment in the extractive industries) has caught CEPAL by surprise, just as both the neoliberal and the national-popular governments.

Back in the 1980s, the UNEP Regional Office discussed several other issues around the binary development and environment. One of the questions addressed the roles that the small producers and large business owners play in the deterioration of nature. Some sustained that, as peasants were obliged to occupy lands of lesser quality at the agricultural frontier, they generated soil degradation. However, other indicators exist that support the view that the processes of degradation and dilapidation were caused by large landowners.

Later, in response to the Brundtland Report of 1987, another study called *Our Own Agenda* was elaborated by UNEP and Inter-American Development Bank (IDB), and coordinated by the hydraulic engineer Arnaldo Gabaldón (the Venezuelan minister of the environment) (Gabaldón, 1994).[3] Gilberto Gallopin, Vicente Sánchez and other expert authors participated, proposing to the governments, to the NGOs and to society at large that the agenda be incorporated into the Rio meeting of 1992. Part of this work was published in more accessible language by Sejenovich and Panario (1996). All of this contributed, on the one hand, to the United Nations' Agenda 21 and, on the other hand – within civil society – to the various alternative Treaties of NGOs in Rio 1992. At the official conference, the Convention on Climate Change and the Biodiversity Convention were signed by all countries (with the sole exception of the USA). At that time, a prominent Latin American representative was Jose Lutzenberger, who had published the ecological manifest, *End of the Future?* (*Fim do Futuro?*) in 1976. As Brazilian minister of the environment, Lutzenberger asked in 1992 that the World Bank not lent any more money to Brazil (Hochstetler and Keck, 2007: 74ff). He was forced to resign.

In parallel meetings to Rio 1992, popular environmentalism emerged in a very public and urgent fashion. In fact, 1,500 organizations from all over the world met to debate the treaties that the governments were discussing, and effectively drafted alternative treaties that were much more exigent, including one about "ecological debt" (Alternative Treaty, n. 13). Despite all of this, the anti-environmentalist prejudice in Latin American official circles continued for decades, until today. Instead of using Chico Mendes (assassinated in December 1988) as a symbol of popular Latin American environmentalism, an international official conflict evolved over the interpretation of the struggle of rubber tappers against deforestation. Fearing initiatives that would internationalize the Amazon, so as to not passively let Brazil destroy it, the president of Brazil conspicuously left a public meeting.

In conclusion, from Stockholm in 1972 until Rio+20 in 2012, Latin American governments have emphasized that the solution to the environmental problem does not consist of halting economic growth, but rather that the main and ultimate solution resides in changing the unequal distribution of power and wealth in the world, and by stimulating distinct styles of development in accordance with each ecological and social reality at national and continental levels (Estenssoro Saavedra, 2014: 155). At the governmental level there was, and is still, a lack of a sense of urgency about the continuing destruction of biodiversity and about climate change (the concentration of carbon dioxide in the atmosphere rose from 360 ppm to 400 ppm between 1992 and 2012). Empathy for popular ecology has also been missing. Neither peasant agroecology nor post-developmentalism nor popular environmentalism – as discussed below – has been part of Latin America's official "own agenda".

Popular environmentalism

Governmental and international debates over new environmental policies occurred at the same time that a debate emerged in civil society which quickly grew stronger. Influenced by the new ideas of Liberation Theology and different social movements in the region, a widely shared critique of the economic growth models in Latin America would give voice to a popular environmentalism, or the environmentalism of the poor. It drew from the ideas of two important Latin American thinkers. Paulo Freire emphasized social and environmental justice, local knowledge, the morality of political decisions, and respect for the planet and its diverse habitats. These ideas led some to adopt a fundamental rejection of capitalism; others regarded it as an agenda that was more cultural and moral, and which could present an alternative to materialist developmentalism. The other thinker with great influence in the debate was the Uruguayan writer Eduardo Galeano. In his 1971 book *Open Veins of Latin America* (*Las Venas Abiertas de América Latina*), he presented a ferocious critique of the extractivist logic throughout all of Latin America's history. The book became an iconic text in the debates over the consequences of extractive capitalism and the social and ecological destruction in the region. In recent years another Uruguayan, Eduardo Gudynas (2009), attracted many followers for his elaboration of "post-extractivism". Meanwhile, Maristella Svampa leads a flourishing group of Argentinean authors doing excellent political ecology research with

an "anti-extractivist" agenda (Svampa, 2011, 2013, 2015), as do Gian Carlo Delgado in Mexico (Delgado Ramos, 2000) and Mario A. Pérez Rincón in Colombia (Pérez-Rincón, 2006, 2014).

In the 1970s and 1980s, nationalist-popular political parties (in the style of Peronismo in Argentina and the American Popular Revolutionary Alliance (Alianza Popular Revolucionaria Americana (APRA) in Peru, before their incongruent neoliberal moments with presidents Menem and Alan García) had protested against the insertion of Latin America in the world economy as provider of raw materials and with episodes of terrible indebtedness. And they were joined by other political currents. For example, the influential Argentinian economist Aldo Ferrer of the Radical Party presented a well-argued plea for "living within our means" in 1983 (Ferrer, 1983). This has been replaced in recent times by a "commodity consensus" (or a new "Beijing consensus") at an official level.

Beyond the government and international debates directed towards new public environmental policies and beyond university research, a popular environmentalism developed with greater force encompassing movements that are sometimes purely reactive and that, in general, do not aspire to achieve political influence per se. Instead they emerged as a reaction to specific environmental problems, which are often local but have worldwide importance. In this sense, one can see Latin American agroenvironmentalism as an international movement that is not only defensive but one that also makes propositions that show the "productive ecological rationality" about which Enrique Leff speaks (Leff, 2004).

Much of the resistance manifested in popular environmentalism did not create permanent alternatives but was rather linked at one point or another to specific places of mineral extraction or investment projects. The protests in Mexico in the 1980s against the nuclear plant in Laguna Verde present a now distant example. There have been many instances of resistance to dams, which lasted for decades and eventually led to nothing. The local movement in Ecuador against copper mining in Intag is a current example. They resisted and succeeded against Mitsubishi in 1995 and against Ascendant Copper (of Canada) in 2006, and developed productive alternatives such as the trade of organic coffee and ecotourism. After these victories, in 2014 it suffered the ravages of President Correa's policies ("we shall leave extractivism behind through more extractivism") in alliance with the state-owned company Codelco of Chile.[4]

Popular environmentalism, otherwise known as the environmentalism of the poor and indigenous, is above all the expression of a "moral

economy" that confronts commodification and manifests itself in the commodity-extraction frontiers (Martínez-Alier, 1992, 2005). The peasant and indigenous populations protest against the extractive industries of minerals and biomass, using distinct languages of valuation. They succeed in halting conflictive projects in perhaps 20% of the cases, according to the inventories of the EJOLT (Environmental Justice Organizations, Liabilities and Trade) Project (www.ejatlas.org). Sometimes they demand monetary compensation for the damage inflicted or for that which they are going to suffer; other times they argue in terms of inalienable territorial rights, they appeal to Convention 169 of the International Labour Organization (ILO), or they argue that landmarks that are going to be destroyed (hills, rivers, lakes) are sacred. They oppose the loss of common goods and natural resources that they need to live and survive. Not only in the countryside but also in the city there are groups of relatively poor citizens who, without being "card-carrying" environmentalists, protest when they lose green areas of public use, demand space for pedestrians or cyclists, and practise urban horticulture.

Today, this Latin American popular environmentalism congregates in (virtual) networks of information and agitation such as those of the Observatory of Mining Conflicts in Latin America (Observatório de Conflitos Mineiros da América Latina (OCMAL)) and the Latin American Observatory of Environmental Conflicts (Observatorio Latinoamericano de Conflictos Ambientales (OLCA)), both based in Chile. There are parallels and connections (through international networks such as Oilwatch, the World Rainforest Movement (WRM), the Vía Campesina and Latin American Coordination of Rural Organizations (Coordinadora Latinoamericana de Organizaciones del Campo (CLOC)) with resistance movements in India and Africa, and there are also similarities with the movement for environmental justice in the USA. Networks such as the MAB (Movement of People Affected by Dams/Movimento dos Atingidos por Barragens) in Brazil and MAPDER (Movement of those Affected by Dams and in Defence of Rivers/Movimiento Mexicano de Afectados por las Presas y en Defensa de los Rios) in Mexico (which oppose dams) are also connected with international movements. This popular environmentalism has made itself visible in a great number of local conflicts that have arisen in recent decades. In Latin America, in almost half of the cases collected in the Environmental Justice Atlas (www.ejatlas.org), the indigenous or African-American populations participate as actors in such ecological-distributive conflicts. There are also new networks of statistical political ecology (Pérez Rincón, 2014).

Popular environmentalism does not only have indigenous roots; religion was also important. The book by Brazilian theologian Leonardo Boff, *Ecology: Cry of the Earth, Cry of the Poor* (1996), stands out along with the leadership of former priest Marco Arana in Peru in the movement and political party Tierra y Libertad (Land and Liberty), founded after several years of resistance in Cajamarca against the Yanacocha Mine. Previously there was a movement called Movement of Priests for the Third World, which played an important role in the slums (*villas miserias*) in Argentina and in general with the poor. It was harshly repressed and obliged to dissolve itself, but it reappeared 20 years later in the agrarian leagues of north-eastern Argentina, forming environmental movements in the fight against the soy production that invades the Chaco forest. Alongside this process emerged a non-governmental network called Doctors of the Fumigated Towns (Médicos de los Pueblos Fumigados por Glifosato), which supports the substantial movement called Let's Stop Fumigating (Paremos de Fumigar), with emblematic activists such as Sofia Gatica in Córdoba (Goldman Prize) of the Mothers of Ituzangó (Madres de Ituzangó) movement.[5] In Brazil, the active presence of the Pastoral da Terra is noted in land conflicts in the north of the country (Porto et al., 2013).

The term "ecological debt" was first used in 1991 by Latin American organizations that were opposed to the loss of the ozone layer and to climate change (Robleto and Marcelo, 1992), and it was applied a little later to the results of ecologically unequal trade and instances of "biopiracy". There are other slogans or expressions, such as "water is worth more than gold" (*el agua vale más que el oro*), "water justice" (*justicia hídrica*), "living rivers" (*ríos vivos*), "climate justice" (*justicia climática*), "tree plantations are not forests" (*las plantaciones no son bosques*) (Carrere and Lohman, 1996), "food sovereignty" (*soberanía alimentaria*, from Vía Campesina) and, more recently, "energy sovereignty", which were born in or have been spread across the continent. Environmental justice associations also ask for an international criminal court for environmental damages and an international convention about "ecocide". This is truly very distant from the rhetoric of the "green economy" deployed by the United Nations in the Rio+20 conference of June 2012, not to mention the super-oxymoron of "green growth".

One of the important elements of the environmental justice movement is the word "biopiracy", introduced in 1993 by Pat Mooney (of the Rural Advancement Foundation International (RAFI), which is today Action Group on Erosion, Technology and Concentration (ETC)), and spread on a worldwide scale by Vandana Shiva, frequent visitor to

Latin American countries. In Latin America, Carlos Vicente, author of numerous books on the subject, coordinates the Action for Biodiversity Network. What started as allegations by environmental justice activist organizations against biopiracy has now been converted into legal actions of some governments or court cases in megadiverse countries. In Peru, as in Brazil, the state authorities now speak of "biopiracy". Even the Brazilian minister of the environment, Izabella Teixeira, said in March 2012 – after having fined some companies – that opportunities to advance in the economic valorization of biodiversity should be avoided so as not to "disguise biopiracy actions".[6]

In the regulation of investment projects, advances have been made in imposing a process of public audience for environmental impact assessments (EIAs), which are crucial moments in many socioenvironmental conflicts (Wagner, 2014). The EIAs sometimes provide a setting of participation or of struggle, and allow advancement towards participatory environmental governance. In Tambogrande, Peru, the refusal of the population to participate in a rigged EIA public audience was a step towards a referendum or popular consultation in 2002.[7]

Environmental conflicts do not only consist of local populations on one side and corporations on the other. Local and international NGOs participate, along with state representatives, in a multitude of conflicts not only over the administrative management of the EIAs or granting of mining or oil concessions, but also through other legal channels (with spectacular cases, such as the recent suspension of the Barrick Gold Pascua Lama project in Chile, after investments of thousands of millions of dollars), including court cases. Legislative authorities also sometimes intervene in favour of environmentalism, such as in the prohibition of open-pit mining by various provincial legislatures in Argentina (Wagner, 2014). Mediation bodies can also intervene, such as the ombudsman (*Defensoría del Pueblo*) in Peru and Bolivia. However, in other instances, quite often the police, military and private security forces protected by the state intervene against popular environmentalists. Although there is a consensus between neoliberal and national-popular governments in attributing environmentalism to foreign influences and interpreting it as a phenomenon of "full bellies", it is impossible to ignore the numerous outbreaks of bottom-up environmental mobilizations all over Latin America and the hundreds of victims killed in environmental conflicts in Mexico, Honduras, Guatemala, Colombia, Peru, Brazil and other countries documented by Global Witness, by the OCMAL inventories, the Oswaldo Cruz Foundation (Fundação Oswaldo Cruz (FIOCRUZ)) map of Brazil (Porto et al., 2013), and the EJ Atlas (www.ejatlas.org).

A Latin American ecosocialism?

In the 1980s, new ideas about socioecological politics in Latin America emerged. Authors such as Victor Toledo, Enrique Leff, José Augusto Pádua and Ivan Restrepo formulated more radical ideas about the political context of environmental governance. Augusto Angel Maya's explicit message (1996, 2002) was to avoid interpreting environmental problems as exclusively ecological or technological. He understood the environment as an object of study in all the scientific disciplines, from the natural sciences and technologies to sciences that study human behaviour.

Beginning in the 1980s, activist groups such as the Political Ecology Institute (Instituto de Ecología Política) in Chile, Censat in Colombia, Ecological Action (Acción Ecologica) in Ecuador (composed of young female biologists), REDES (Amigos de la Tierra Uruguay/Friends of the Earth) in Uruguay, FASE (Federação de Órgãos para Assistência Social e Educacional/ Federation of Organizations for Social and Educational Assistance) in Brazil with Julianna Malerba, and others have emerged. There is a strong Latin American environmental thinking that enumerates, and denounces the multitude of environmental conflicts that the growth of the social metabolism brings with it. Some 20 years later, these views have not only been expressed in writings and manifestos of social actors and alternative thinkers of post-developmentalism, of agroecology and of popular environmentalism, but also in some national constitutions, in the discourses of government officials and even by some ministers.

After the defeat in 2005 of the US plans to promote the Free Trade Area of the Americas (FTAA), new leftwing, progressive governments emerged with the electoral victories of Evo Morales in Bolivia (2005) and Rafael Correa in Ecuador (2006). In the following years it even seemed that an international "official" environmental leadership could arise from South America. The Ecuadorian Constitution of 2008, for example, has been a very important symbol of environmental thinking in Latin America, with the presence of Alberto Acosta – ex-president of the Constituent Assembly – in a multitude of forums. Another example was the radical speech of Ecuador representative Fánder Falconí, at the failed climate change conference in Copenhagen in 2009, when he made reference to the ecological debt or climate debt of the North with the South. He compared the poor countries with "passive smokers" and he defended the Yasuni Ishpingo-Tambococha-Tiputini (ITT) initiative to "leave the oil below ground" in front of more than 150 presidents of state and leaders of government.[8]

The contradictions of the new leftwing governments, which had to choose between environmental protection and economic growth, became clear when only a few weeks later Falconí resigned as minister of foreign affairs because of President Correa's refusal to take the Yasuni ITT initiative forward. In Cochabamba, Bolivia, in April of 2010, a large meeting was held after the failure of the United Nations meeting in Copenhagen, attempting to position Evo Morales as an environmental leader of the South, but neither he nor his vice president, García Linera (who believes that environmentalism is a luxury for the rich), was in favour of concrete measures regarding environmental protection. They went rather for the exploitation of the Amazon as in the plan for the TIPNIS (Isiboro Secure National Park and Indigenous Territory/Territorio Indígena y Parque Nacional Isiboro Secure) highway. The Bolivian ambassador to the UN, Pablo Solón, was alone in the insistence on the responsibility of the developed countries for climate change in December of 2010 in Cancún in one more ineffectual climate conference.[9]

The inability of Latin American governments to take on environmentalism as a main issue, and even more the repression and "criminalization" of popular environmentalism, is opening up space for a political environmentalism that is opposed to neoliberal as much as it is to the national-popular governments. Both share the "commodities consensus" (Svampa, 2013). This is leading to a mature Latin American environmentalist political thinking, albeit incipient, proposing new principles of international environmental governance, and also criticizing extractivism and environmentally unequal trade in the defence of the rights of nature, the human right to water, and the integral and sustainable management of resources for the benefit of local livelihoods.

In support of ecosocialism, Enrique Leff in *Ecology and Capital* (1986) and James O'Connor (in the first issue of the journal *Capitalism, Nature, Socialism* (1988)) explained that the growing social and environmental costs caused by economic growth are also the catalysts for an explosion of environmental protest (Leff, 1986, 2012). Currently we see a major global process of dispossessing indigenous and peasant lands by private or state enterprises: expropriating mangroves by the shrimp industry, and land-grabbing for tree plantations and agrofuels, for megamining and dams, and for the extraction of gas and oil. These are neocolonial processes of appropriating natural resources and territories where new actors, such as Chinese companies, appear. There is also much resistance in urban areas, including recycling cooperatives of "scavengers" of urban waste, who play a very important and under-recognized role.

The Latin American Network of Recyclers and Urban Reclaimers has come into existence which has attained notable success in places such as Bogotá under the leadership of Nohra Padilla, who won the 2014 Goldman Prize for grassroots environmentalism.

Conclusion

A common element of Latin American environmentalist thought (absent in Europe and also in India, for example) is the awareness of the demographic disaster brought about by the European Conquest. This led to a perhaps justified disdain for Malthusian approaches in the region. The environmentalism of Paul Ehrlich with his focus on the "population bomb" was never successful in Latin America, where the population density is generally low (in comparison with Europe, East Asia and South Asia). Since the beginning of the 1970s, there has been a profound discussion among Latin American governments and on the part of the UNEP Regional Office to establish a shared environmental position. The 1972 Meadows Report, *The Limits of Growth*, garnered a general rejection in official circles in Latin America. It was emphasized that the problem was not the finite supply of resources but rather their distribution. However, 40 years after this debate, we have indeed found that today there are "planetary boundaries" of resources and sinks. Current world trends are negative in regard to the loss of biodiversity and climate change. Above and beyond this initial negative reaction in the 1970s and 1980s from official circles, and the search for a "Latin America agenda" of its own, we have identified a set of environmental ideas and practices that have emerged in Latin America and which in part coincide and in part diverge from other continents:

- awareness of the demographic disaster after the conquest and a widespread rejection of the Malthusian approach to the problem of overpopulation;
- an agroenvironmental pride, especially present in Mesoamerica and the Andes (and absent in the USA);
- a shared admiration by European and Latin American science (since 1800, with Alexander von Humboldt) for the great biological richness of the continent in its diverse ecosystems, together with conservation programmes implemented since the nineteenth century;
- a keen awareness of global political and economic inequality, and the consequent plundering of natural resources in the region; this

awareness runs from the time of colonial exploitation through to today;
- the rejection by Latin American governments – since Stockholm in 1972 – of the idea of limits to growth, defining an agenda that proposed distinct "styles of development" but eventually accepting a confusing notion of "sustainable development";
- from the 1980s onwards, a growing number of socioenvironmental conflicts that gave way to "popular environmentalism" with networks of activists that denounce the extraction of natural resources and the destruction of the commons;
- the validity of ancient indigenous worldviews, the celebration of *Pachamama* that is recognized in the constitutions of Bolivia and Ecuador, the respect for nature in Afro-American communities, and the contributions of liberation theology; also, on a cultural level, the presence of ecology in twentieth-century literature.

There is clearly a Latin American conservationist environmentalism that is common with other continents: a shared admiration of European science (which is also American science) since Humboldt because of the enormous biodiversity of Latin America's many diverse ecosystems, which were only partially explored. The extraordinary biological richness of not only the Amazonian rainforest but also of other ecosystems (such as the Atlantic forest in Brazil, mangroves and coral reefs, the Andean highlands, the tropical dry forests, the Pantanal, and other wetlands and marshes) are seen as a promise of the economic potential that is not yet confirmed and, on the other hand, periodically leads to protests against "biopiracy".

Conflicts around the extraction and export of natural resources are increasing in Latin America. The resistance against the exploitation of nature has led to the growth of popular environmentalism, to environmental justice movements, to protests against climate injustice and water injustice, and to the defence of the commons. Latin American politicians and public administrators have basically ignored this movement of the environmentalism of the poor, but they have not suppressed it.

Recently, however, there have been signs of an emerging post-extractivist and post-developmentalist environmentalism that attack impartially both the neoliberal and the national-popular governments. Some would call it ecosocialism. This political environmentalism is very distinct from that of European green parties that focus on "ecoefficiency". Post-extractivism is intellectually powerful but still politically

weak, although it seems much reinforced by the declining terms of trade of 2014–2015. This movement attempts to include new concrete proposals for continental and international governance, such as oil and open-pit mining moratoria, campaigns against dams and against the "green deserts" of pine and eucalyptus trees, and the defence of peasant seeds. Rather than the objective of economic growth or development, it proposes an objective of *Buen Vivir* and also to give rights to nature (as in the 2008 Constitution of Ecuador). The Latin American concept of "ecological debt" has been very fruitful and has provoked important debates, as has the emphasis on the human right to water, supported by Bolivia on the experience of the Cochabamba "water wars" of 2000. Latin America is at a crossroads where various critical political and economic theories are seeking a point of convergence with environmentalism, which will give it the opportunity to present a real alternative to extractivism. One of the crucial challenges will be to transfer these debates to the new circles of politicians and policy-makers. This has been a permanent challenge in Latin American environmental history, but today it has a renewed intensity.

Notes

1. Chapter 2 gives statistics on the social metabolism.
2. For Esteva's analysis of the meanings of "development", see https://desarrolloxxi.files.wordpress.com/2010/05/desarrollogustavoesteva1.pdf
3. See Garcia-Guadilla (2013) for an interesting account of "neoextractivism" and its conflicts in today's Venezuela.
4. www.http://codelcoecuador.com/news/ and Rafael Correa, Discurso para la XIV Cumbre Iberoamericana, Veracruz, Mexico, 8 December 2014: "Debemos hacer uso del extractivismo para salir de él".
5. See, for instance, https://noticiasdeabajo.wordpress.com/2012/07/30/informe-del-primer-encuentro-nacional-de-medicos-de-pueblos-fumigados/
6. See http://www.bbc.co.uk/mundo/noticias/2012/03/120323_biopirateria_brasil_lp.shtml
7. See Chapter 11 about local referenda or popular consultations against mining investments.
8. See https://mail.uevora.pt/pipermail/ambio/2009-December/015749.html, taken from the webpage of the Ministry of Foreign Relations of Ecuador.
9. Chapter 4 compares post-neoliberal environmental governance in Ecuador and Bolivia.

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2
Social Metabolism and Conflicts over Extractivism

Joan Martinez-Alier and Mariana Walter

Introduction

The natural resource conflict dimension of environmental governance is usually centred on the social and political aspects of production systems and has hardly addressed the biophysical features of the natural resources themselves. Here we aim to address renewable and non-renewable resource-extraction conflicts in Latin America in the context of a changing global social metabolism and increasing demands for environmental justice (M'Gonigle, 1999; Sneddon, Howarth and Norgaard, 2006; Gerber, Veuthey and Martínez-Alier, 2009; Martinez-Alier et al., 2010). "Social metabolism" refers to the manner in which human societies organize their growing exchanges of energy and materials with the environment (Fischer-Kowalski, 1997; Martinez-Alier, 2009). In this chapter we use a sociometabolic approach to examine the material flows (extraction, exports, imports) of Latin American economies and furthermore look into the socioenvironmental pressures and conflicts that they cause. Sociometabolic trends can be appraised using different and complementary indicators. For instance, the Human Appropriation of Net Primary Production (HANPP) measures to what extent human activities appropriate the biomass available each year for ecosystems (Haberl et al., 2007). Other examples are indicators that study virtual water flows, the energy return on investment (EROI) or a product life cycle. Each indicator provides information on different aspects of our economic performance.

In this chapter we will address the economy-wide material flow analysis (MFA) in more detail. The MFA is "a consistent compilation of the overall material inputs into national economies, the material accumulation within the economic system and the material outputs to other economies or to the environment" (EUROSTAT, 2001: 17). MFA aims

to complement the system of national accounting with a compatible system of biophysical national accounts, using tonnes per year as the key unit of measurement. Such methodology provides a picture of the physical dimension of the economy, where the total turnover of energy and materials of the socioeconomic system can be analysed historically or cross-sectioned through the accounting of input flows (tonnes of biomass, fossil fuels, construction minerals, etc.) or output flows (tonnes of materials exported, waste or pollutant generated). Focusing on the input side by taking into account all materials that enter into the national economy allows for an acknowledgment of the physical dimension of foreign trade and can determine the amount of all outputs transferred to the environment (Gonzalez-Martinez and Schandl, 2008). While MFA presents some limitations regarding, for instance, the qualitative differences between materials (i.e. toxicity, environmental or social context of extraction), it offers a picture of the overall evolution of the pressures exerted by an economy to extract renewable and non-renewable resources.

A social metabolic approach acknowledges that inputs into the economy ultimately become outputs from the economy in the form of waste (except for the part that accumulates as a stock, as in buildings). The main output in volume from rich economies (apart from wastewater) is carbon dioxide from the burning of fossil fuels, the excessive production of which is a main source of climate change. Solid wastes produced by the economy are disposed of locally (in landfills or incinerators), or sometimes exported to distant regions or countries. All goods circulate through "commodity chains" (Raikes, Friis Jensen and Ponte, 2000) – that is, from cradle to grave or from point of extraction to waste disposal. Ecological distribution conflicts occur at different stages as peasant or tribal groups, national or multinational companies, national governments, local or international NGOs, and consumer groups are all stakeholders.

Economic change generally occurs for the benefit of some groups and at the expense of other existing or future groups (Hornborg, 2009). Externalities can be positive (like the free environmental services provided by a forest) or negative. Negative externalities are not seen here as market failures but rather as (provisional) cost-shifting successes (Kapp, 1950). Optimistic views regarding ecological modernization, the "dematerialization" of the economy (Stern, 2004), are confronted with the reality of increased inputs of energy and materials into the world economy, thereby increasing the production of waste and ecological distribution conflicts.

Ecological distribution conflicts are struggles over the burdens of pollution or over the sacrifices made to extract resources, and they arise from inequalities of income and power (Martinez-Alier and O'Connor, 1996; Douguet, O'Connor and Noel, 2008). The concept of ecological distributive conflicts is born of the intersection between the fields of ecological economics and political ecology, which links the emergence of environmental conflicts in the global South with the growth of the metabolism of societies in the global North (which includes parts of China). Political ecology focuses on the exercise of power in environmental conflicts. In other words, the question is: Who has the power to impose decisions on resource extraction, land use, pollution levels, biodiversity loss, and more importantly, who has the power to determine the procedures to impose such decisions (Martinez-Alier, 2001, 2002; Robbins, 2004)?

Ecological distribution conflicts emerge from the structural asymmetries in the burdens of pollution and in the access to natural resources that are grounded in unequal distributions of power and income, and in social inequalities of ethnicity, caste, social class and gender (Martínez-Alier, 1997; Martinez-Alier et al., 2011). As processes of valuation surpass economic rationality in attempts to assign market prices and chrematistic costs to the environment, social actors mobilize for material and symbolic interests (of survival, identity, autonomy and quality of life), beyond strictly economic demands of property, means of production, employment, income distribution and development (Leff, 2003). Sometimes the local actors claim redistribution, leading to conflicts that are often part of, or lead to, larger struggles of gender, class, caste and ethnicity (Agarwal, 1994; Robbins, 2004). Hence the concept of "environmental justice" is important. It was born in the USA (Bullard, 1990) and it has gained growing acceptance in extractive industries, water use and waste-disposal conflicts all over the word (Urkidi and Walter, 2011). Not all conflicts are born from immediate metabolic needs. Demand for certain commodities such as gold arises in part from the search to have an investment outlet that furthermore allows for speculation. Other metals, such as copper, can also be stored and used as guarantees for speculative loans. The fact remains that both energy-carriers (coal, gas, oil) and metallic minerals are inputs for the industrial economy and that their use, in total, grows more or less in proportion to the growth of the economy.

In this chapter, we analyse the material flows of Latin American countries and their implications in terms of socioenvironmental conflict. First, we present an overview of recent material-flow studies

conducted in this region. Second, we examine in further detail the socioenvironmental pressures exerted by the extraction of renewable and non-renewable materials. We propose a classification of extractive conflicts based on the commodity at stake. With this double approach we address the process of growing primarization of Latin American economies, its trends and some of its drivers, while simultaneously exploring the local pressures and conflicts that this process is fostering. At the macroeconomic level, we point to the paradox that the large physical exports are unable, or scarcely able, to finance the imports so that many countries are falling into commercial deficits.

Latin American sociometabolic trends

Different indicators can be used to analyse Latin American sociometabolic features and trends. Here we consider recent MFA studies conducted on Latin American economies and discuss their implications in terms of socioenvironmental pressures and injustices. MFAs have been conducted in most Organisation for Economic Co-operation and Development (OECD) countries, but only recently has research been conducted in the Latin American region and some of its countries in particular, such as Argentina (Perez-Manrique et al., 2013), Colombia and Ecuador (Russi et al., 2008; Vallejo, Pérez Rincón and Martinez-Alier, 2011; West and Schandl, 2013; Samaniego, Vallejo and Martinez-Alier, 2014). MFAs conducted on the overall region indicate that there was a four-fold increase in material flows between 1970 and 2008 for domestic consumption and also for exports. The Latin American economy has certainly not become "dematerialized" – one could compare such trends with other geographical regions, such as Europe, where the rate of increase in material extraction has been much lower, or with India, which has a lower rate of material extraction per capita than Latin America and which is not a net exporter in physical terms (Singh et al., 2012). Such physical indicators are useful for characterizing the economic structure of countries and regions.

Latin American economies, and particularly South American economies, have a persistent and increasing physical trade deficit (West and Schandl, 2013). The physical trade balance (PTB) is the difference between the number of tonnes of materials that are imported by an economy and the number of tonnes that are exported. The monetary trade balance (MTB) is the difference between how much is paid for the imports and how much is earned by exports in monetary terms. Exports in tonnes are larger than imports in tonnes, resulting in a

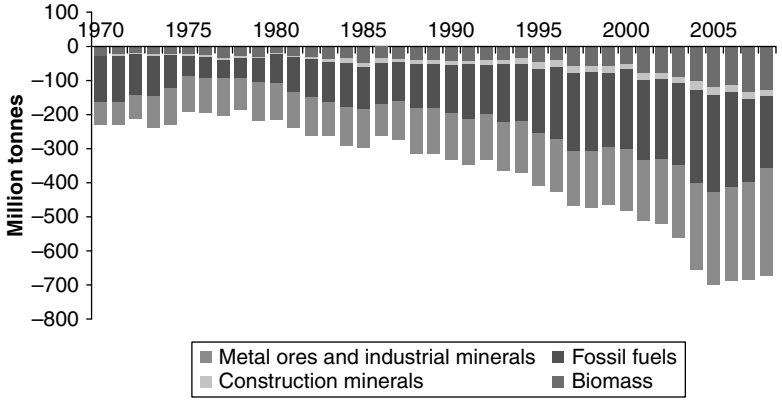

Figure 2.1 Latin America physical trade deficit in million tonnes, 1970–2008
Source: UNEP and CSIRO, 2013.

"deficit" in the same sense that would be applied to a tree plantation that grows less than the harvest rate. Figure 2.1 presents a yearly PTB of the Latin America region (including Mexico) per type of material from 1970 and 2008. Note in Figure 2.1 the increased physical trade deficit for metal ores and industrial minerals, which reflects the growing pressure to extract and export these materials. While one tonne of uranium is, of course, environmentally very different from one tonne of sand and gravel, or one tonne of cellulose from one tonne of shrimp, our aim here is to show trends within broad material categories, where the shift in the composition by commodities is not that important. Later we take a closer look at the different commodities within the categories of biomass and metal ores.

There are internal and external pressures to increase the extraction of materials, for domestic use and for export. Such increasing pressures to extract materials displace the commodity frontiers (Moore, 2000) to new territories often inhabited by peasant and indigenous groups, who complain accordingly as we signal in further detail in the next section (Conde and Walter, 2014). In regard to external trade, trends point to a structural persistence of an "ecologically unequal exchange". This concept challenges the argument that exports from developing nations foster economic growth and development, and points to the physical and socioenvironmental trade-offs at play (Hornborg, 1998; Muradian and Martinez-Alier, 2001; Bunker, 2007). Studies in this field highlight how poor countries are exporting goods at prices that do not take into

account local externalities or depletion of natural resources, in exchange for the purchase of expensive goods and services from richer regions. One can measure ecologically unequal trade in terms of the inequality of various dimensions, such as hours of labour, hectares of land, tonnes of materials, water footprints, and joules or calories. When all or most indicators point in a similar direction, then we can state that there has been an unequal exchange (Hornborg, 2006). Ecologically unequal exchange arises from the structural fact that the metropolitan regions or countries require increasing amounts of energy and materials at cheap prices for their metabolism.

The terms of trade are persistently negative for South America as a whole and for most countries individually (one tonne of imports is always more expensive than one tonne of exports, from two to five times) in the very long term. However, the terms of trade improved somewhat in the first decade of the twenty-first century, fuelling a wave of optimism regarding economic growth but later deteriorating again (Samaniego, Vallejo and Martinez-Alier, 2014). Currently, the large physical exports can scarcely pay for the imports in most South American countries. A large physical trade deficit does not imply a positive MTB, and, on the contrary, recent LA trends point to simultaneous physical and monetary deficits. Either in 2013 or 2014, or in both years, there were commercial deficits in Brazil, Colombia, Ecuador, Peru and other countries. While Argentina's commercial surplus has been much reduced, there is now a need to finance commercial deficits (Samaniego, Vallejo and Martinez-Alier, 2014). For Argentina, our analysis of the external trade over a long period (1970–2009) shows (Figure 2.2) small monetary surpluses since the end of the 1990s (in 2001–2002 the surplus increased because the economic crisis violently reduced imports). Such small monetary surpluses almost disappeared in 2013–2014. From a physical point of view, Argentina has exported increasing amounts (in tonnes) since the early 1990s (between three and four times its imports in tonnes), thus demonstrating structurally negative terms of trade.

We do not enter into a detailed study here of the physical structure of external trade in the sense of looking at its biomass, mineral and fossil-fuel components (Perez-Manrique et al., 2013; West and Schandl, 2013). We point out, however, that Argentina exports – like Brazil – large amounts of biomass. In comparison, another large South American country, Colombia, does not export large amounts of biomass products but it does export large amounts of coal. The PTB of Colombia shows long-term trends that are not very different from those of Argentina,

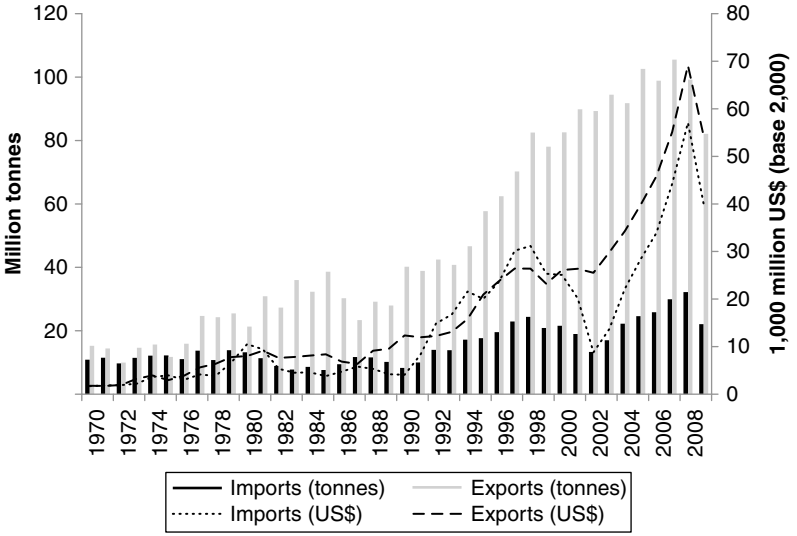

Figure 2.2 Argentina's physical and monetary external trade flows, 1970–2009
Source: Walter et al. (2013).

namely, physical exports exceed physical imports by a factor of no less than three (Figure 2.3). It must be noted that Colombia's large physical exports (which entail large unpaid socioenvironmental liabilities) are now unable to pay for the imports. As Figure 2.3 shows, in 2011, Colombia exported about 120 million tonnes and imported about 30 million tonnes, leaving a physical trade deficit of more than 90 million tonnes. This is for a country of more than 45 million inhabitants. Argentina, with a population of about 40 million, has reached exports of about 100 million tonnes and imports of about 30 million tonnes (Perez-Manrique et al., 2013). Similar trends, with slight differences, are identified in Brazil, Ecuador and Peru. Growing exports in tonnes (of different commodities) are not succeeding in improving the MTBs due to the negative terms of trade (Vallejo, Pérez Rincón and Martinez-Alier, 2011; Pérez-Rincón, 2014; Samaniego, Vallejo and Martinez-Alier, 2014).

To conclude this section, the critiques against extractivism have a double economic foundation. Domestic extraction and exports increase as they are driven by internal and external demand. Raw materials-based economies incur disproportionate environmental costs, which are not factored into the price of commodities (Rice, 2007; Jorgenson, 2009; Roberts and Parks, 2009). Moreover, exhaustion of resources is

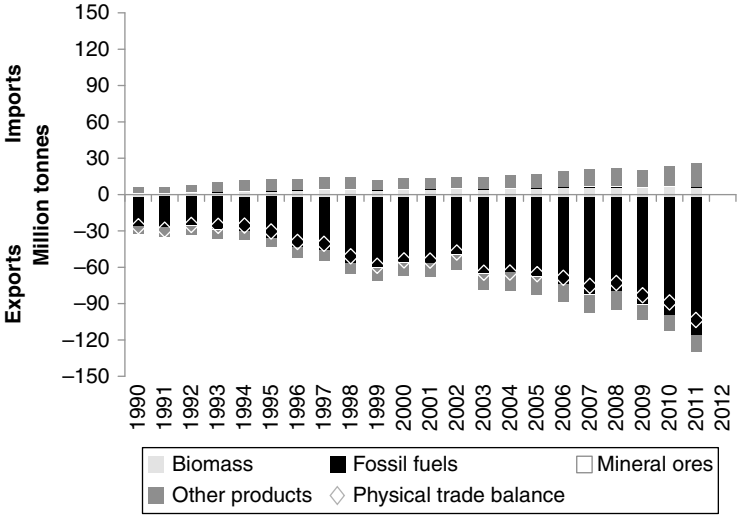

Figure 2.3 Physical trade balance of Colombia, 1990–2011
Source: Samaniego et al. (2014) based on COMTRADE, DANE.

renamed as "production" and it sustains periodic periods of bonanza. Outside demand does increase because of the metabolic needs of the world industrial economy. The recent growth of Asian economies, and China in particular, is exacerbating the primarization of Latin American economies by boosting the pressure to extract environmentally sensitive resources (Muradian, Walter and Martinez-Alier, 2012). Recently, an absurd situation has been reached: not only are the environmental costs of the booming extractive activities not accounted for, and the exhausted resources not replenished, but, moreover, the great excess of physical exports over imports is not able to pay for the imports. The commercial deficits will have to be compensated for by foreign investments or other forms of debt, which in due course will produce repayments to foreign countries. These are becoming key drivers that strengthen extraction trends, thereby expanding the commodity frontiers and reaching areas of high biodiversity and cultural value – the land of indigenous and peasant communities.

Extractive conflicts in Latin America

As pointed out in the previous section, there is an ongoing boom in the extraction of commodities in Latin America, and a large share of

these materials is exported. This boom has been related to an increase in the number of extractive conflicts, which we frame as "ecological distribution conflicts". In order to elucidate the connections between sociometabolic trends and extractive conflicts, we propose a typology based on the commodity at stake. For each commodity type we will briefly explain some key features and illustrate with examples. Each commodity has its particularities and, as a result, different typologies could be proposed. We don't claim that the one used here is the best or the only possible one, but we use it as a guiding tool to distinguish key trends and features. We propose a classification that distinguishes between biomass (crops, plantations, fisheries) and minerals (metal ores, fuels, industrial, construction materials).

Within this typology, other subclassifications could be considered. For instance, from a social metabolism point of view, another distinction can be made between precious materials and bulk commodities when considering metallic minerals or biomass products (Wallerstein, 1974). Precious materials, such as diamonds, gold or shrimp, have a high economic value per unit of weight but are physically not necessary as inputs for the metabolism of the importing countries, compared with "bulk commodities", such as oil, gas, copper, iron, wood or soyabeans. This distinction does not mean that gold does not play an important social and economic role in the world of jewellery-making, in the world of love and marriage (as in India) or in the world of financial investments (Ali, 2006), but the difference stands in the point of view of the metabolism of the importing economies. Moreover, this difference is also related to different drivers for extraction and the related socioenvironmental pressure exerted.

Biomass

Extractive conflicts related to biomass involve a range of activities, including soy, oil palm and timber production, plantations, fisheries, and mangrove destruction and other deforestation. We could also include related conflicts such as those over the use of glyphosate (for the production of genetically modified organisms, such as soy) and over the implementation of projects for Reducing Emissions from Deforestation and Forest Degradation (REDD).

Let us consider here the case of Argentina (Perez-Manrique et al., 2013). As shown in Figure 2.4, biomass is the predominant material flow of this economy. On average, biomass represents 70% of all materials extracted in the country from 1970 to 2009, of which 71% comprise fodder for livestock (forage, silage, grazing and by-products),

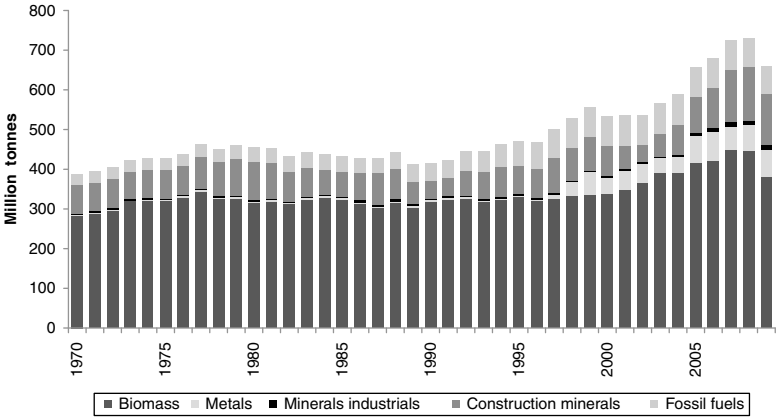

Figure 2.4 Domestic extraction in Argentina, 1970–2009
Source: Walter et al. (2013).

2% fishing and forestry biomass, and 27% crops. From 1997 to 2009, biomass extraction from primary crops increased from 50 megatonnes (Mt (1 million tonnes)) to 137 Mt, mainly for export. Soyabeans constitute the predominant flow within the primary crops. According to Pengue (2001), soyabeans (mostly genetically modified) have displaced other domestically produced crops such as cereals, roots, tubers, vegetables and melons. Indeed, during the period studied, these crops have decreased their participation in the primary crop extraction from 44% to 25% for cereals, from 6% to 2% for roots and tubers, and from 5% to 2% for vegetables and melons. From 1970 to 2009, Argentina's soyabean production jumped from 26,000 tonnes to 30.9 Mt. This growth was driven by high international prices for this commodity from the 1990s onwards, and by technological factors such as the mechanization of agriculture, and the introduction of transgenic soyabeans and chemical weeding with glyphosate (Teubal, 2006). Since the introduction of genetically modified soyabeans in Argentina in 1996, this crop represents an average of 26% of all primary crops.

The rise in crop production led to the expansion of the agricultural frontier, thereby clearing land and forest as well as displacing indigenous and rural communities. Since the 1990s, Argentina has been experiencing one of the largest processes of deforestation in the history of the country (UMSEF, 2007). This entails new issues, such as the weakening of food security, as crops are mainly exported and the production of locally consumed crops is decreasing. The growing use of agrochemicals

produces water, air and soil pollution, and causes health impacts on the surrounding populations (Binimelis, Pengue and Monterroso, 2009). The harvested area of soyabeans multiplied from 38,000 hectares (Ha) in 1970 to 18 million Ha in 2009, accounting for more than half of the total agricultural land (MAGyP, 2011). The predominant biomass flow in the economy of Argentina is still grazing, foraging, silage and by-products. Nevertheless, the expansion of soyabean crops diminished the amount of land available for cattle-grazing. Millions of hectares that were in agricultural-cattle rotation have been allocated to permanent agriculture, while livestock increasingly depends on feed crops (i.e. cereal, soymeal) (Santarcángelo and Fal, 2009; PEA, 2010).

These trends have contributed to an increased number of conflicts over land in Argentina, as peasants and indigenous groups are confronted with the expansion of the soy-extraction frontier into their lands (Aranda, 2010). The expansion of the agricultural frontier has led to the clearing of lands and forest, as well as the displacement of many indigenous and rural populations (Teubal, 2006). This has resulted in various conflicts over access to land. This is the case for the inhabitants of La Primavera (Formosa, Argentina), who have been displaced by the expansion of soy production ever since 2008. Indigenous communities have been dispossessed of their lands, and the Qom people are struggling to recover 5,000 Ha (Asociación Civil Nodo Tau, 2010; García-López and Arizpe, 2010).

The increased use of chemicals in genetically modified (GM) crops has also triggered an increasing number of conflicts related to the health impacts. This is the case for the "mothers of Ituzaingó" of Cordoba, who lead a movement that is mainly composed of women who since 2001 have been demanding that the provincial government stop the air fumigation of soy fields. The spraying of large amounts of glyphosate near urban areas was causing cases of cancer (mostly in children) and birth defects induced by contamination. In 2009 the movement succeeded in forbidding the spraying of this product in urban areas (GRR, 2009). Incidentally, some invasive species such as Aleppo sorghum (or Johnsson grass) acquired resistance to glyphosate spraying, and as a result agriculture steps not only into a pesticide treadmill but also into a "transgenic treadmill" (Binimelis, Pengue and Monterroso, 2009).

Tree plantations have similarly been the subject of socioenvironmental conflicts. As analysed by Gerber (2011), industrial tree plantations for wood, palm oil and rubber production are among the fastest-growing monocultures and are currently being promoted as carbon sinks and energy producers. Such plantations are causing a large number of

conflicts between companies and local populations, mostly in the tropics and subtropics. Relying on the most comprehensive literature review to date, corresponding to 58 worldwide conflict cases (drawing on the WRM database), Gerber (2011) finds that the prominent cause of resistance is related to corporate control over land that results in displacements and the end of local uses of ecosystems as they are replaced by monocultures.

Biomass conflicts related to fisheries and shrimp aquaculture are also relevant in Latin America. Let us briefly consider here the environmental injustices related to the promotion of the shrimp aquaculture industry in Central America, in the Gulf of Fonseca region of Nicaragua and Honduras on the Pacific Coast. This is one of the most densely populated areas in Central America and also one of the poorest. This regional economy depends, to a large extent, on artisanal fishing, specifically shellfish harvesting. Industrial aquaculture activities began in Honduras at the start of the 1970s and in Nicaragua in the second half of the 1980s with small-scale projects. Nowadays this activity has sharply increased. According to the Food and Agriculture Organization (FAO) of the United Nations, in 2008 production had reached 26,584 tonnes, and 14,690 tonnes in Honduras and Nicaragua, respectively. This implies an increase in total production of more than 200% in both countries over ten years (1998–2008). Most of the production is for export, mainly to the USA and to European markets. Where there were once estuaries and natural lagoons, nowadays there are large ponds for producing shrimp. In Nicaragua the surface area under production expanded from 771 Ha in 1989 to 10,396 Ha in 2009, and in Honduras from 750 Ha in 1985 to 14,954 Ha in 2000 (Mestre Montserrat and Ortega Cerdà, 2012).

What was supposed to become a source of wealth for the regional economy has disempowered local fishing communities, which have seen their access to natural resources enclosed and limited. This has triggered serious social conflicts in the region. The industrial sites are located in areas populated by poor communities that rely on the communal use of coastal resources. The main response of the shrimp industry to the theft of their product has been the armed surveillance of their lands, both private and public. This has been a common practice in Nicaragua since 2008, when an agreement was established between the Association of Aquaculturalists of Nicaragua and the armed forces. These measures have further limited the access of local communities to coastal resources, fostering conflict and further impoverishing the population, thereby increasing social marginalization and unrest. As Mestre Montserrat and Ortega Cerdà (2012) indicate, successive conflicts

between security forces protecting aquaculture farms and local fishermen have caused various injuries and at least one death in Nicaragua, and twelve deaths in Honduras. Fishermen have reported cases in which navigation to their fishing grounds through the estuarine channels has been restricted, along with cases of detention and harassment – in the form of constant demands for documentation to be shown – at sea. In Honduras, people engaged in campaigns to resist the expansion of the shrimp industry into protected areas have also been detained.

In Latin America, as elsewhere, the views of social groups involved in such conflicts over biomass are expressed in different "languages", using, for example, discourses about land and territorial dispossession, territorial rights, biopiracy, consultation rights, health impacts (due to chemical use), food sovereignty, human rights (given criminalization and militarization of extractive activities) and democracy. Unsustainable biomass extraction is also linked with conflicts over the rights of nature and of future generations, as biodiversity and nature's genetic pool are affected (by reducing the diversity of crops or advancing towards high-diversity areas). Potential future conflicts could also arise as intensive agricultural practices affect the long-term quality of soils (Pengue, 2001, 2004; Binimelis, Pengue and Monterroso, 2009).

Minerals

Mineral mining includes a range of commodities that can be grouped as metals (e.g. copper, gold, silver, iron, bauxite, uranium, nickel), mineral fuels (e.g. oil, gas, coal, shale oil), industrial minerals (e.g. phosphates, asbestos, salt) and construction minerals (e.g. sand, gravel, stones). The general stages of the mining process are shared: exploration to locate and characterize the mineral deposits, exploitation to mine the ores, mineral processing to refine the mineral, and transport to the consuming economies. However, the features and impacts of each commodity vary. Here we present some key features of the different minerals, and analyse in more detail metal and fuel minerals whose extraction is currently triggering significant debates in Latin America.

Metal ores

The extraction boom of raw materials in Latin American has been particularly significant for metal ores (see Figure 2.5). While in 1970 the weight of industrial and metal ores accounted for 10% of the total material flows of Latin America, in 2009 it reached 25%. In fact, in 2009, industrial and metals ores were, after biomass, the second greatest material extracted and, in part, exported from the region, accounting

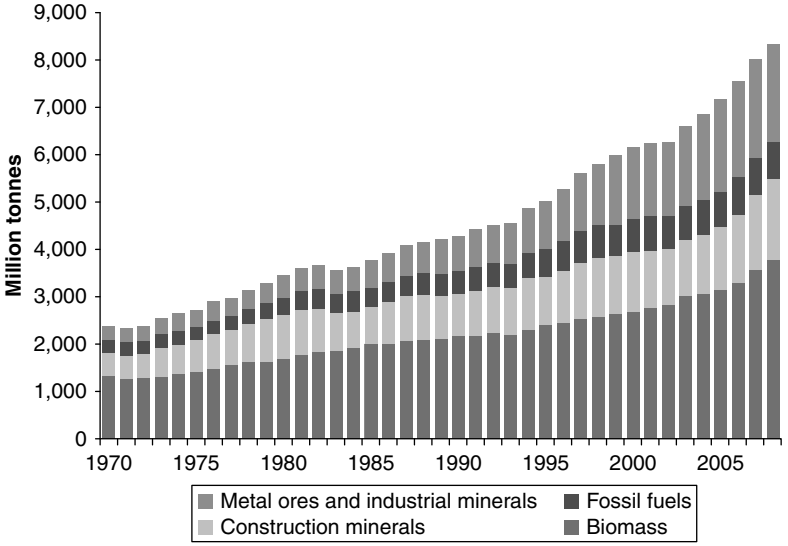

Figure 2.5 Domestic extraction in Latin America by major category of material, 1970–2008
Source: UNEP and CSIRO (2013).

for 2,100 million tonnes of ores (West and Schandl, 2013). In 2012, Latin America provided 45% of the global copper output, as well as 50% of silver, 26% of molybdenum, 21% of zinc and 20% of gold (Henriquez, 2012), attracting a third of global metal-mining investments (US$210 billion) (Ericsson and Larsson, 2013). We will address with some detail metal ore extraction features and trends that are currently related to a boom of conflicts in Latin America.

One of the particularities of the metal-mining production chain is that its initial stages are characterized by low value but high environmental cost: resource extraction and then processing/refining have the highest impact. Later stages, such as assembling, are estimated to have less environmental impact but generate the majority of the economic value. This relationship represents a general trend of the impact/value curve that also applies more generally to other products that use metal ores (Giurco et al., 2010). Moreover, the socioenvironmental impacts of resource extraction increase when ore grades decline, as more waste is generated. As pressure to extract ores increases and the extraction frontier expands, reaching lower quality deposits, the environmental pressures in the stages of extraction and processing become greater (Giurco et al.,

Table 2.1 General conversion factors of gross ore versus metal content and ore concentrate

Metal	Gross ore/metal content	Gross ore/concentrate
Iron	43.32	81.93
Copper	1.04	3.33
Nickel	1.83	23.45
Lead	11.86	16.52
Zinc	8.34	14.50
Tin	0.24	0.33
Gold	0.00021	0.06630
Aluminium	18.98	67.55
Silver	0.034	2.552
Uranium	0.0015	0.3744

Source: Based on Schoer et al. (2012).

2010). Table 2.1 presents general conversion factors for the relationship between metal ores or concentrates and the gross ore that is mined. This factor is derived from the average of the annual business reports of about 160 metal mines in the world (Schoer et al., 2012).

Precious materials, such as gold, have the highest generation of overburden. As indicated in Table 2.1, to obtain 2 grams of gold, an average of 1 tonne of gross ore has to be mined. As the price per unit of precious metals is higher than for bulk metals, it becomes economically feasible to extract ore of decreasing quality or grade, entailing the processing of larger amounts of ore in open-cast mining and, as a result, generating increasing amounts of waste rock and tailings. This has also been made possible with the development of (more intensive) processing techniques that allow miners to obtain metals from decreasing ore concentrations (i.e. cyanide leaching for gold) (Bridge, 2004).

Moreover, other studies point to a worldwide decline in the quality of ore.[1] As the high-grade ores have been depleted, the mining frontier moves to lower-grade ores, with increasing environmental costs. The decline in the quality of ores has direct implications in terms of land intervention of mining activities, as larger mines (open-pit mining) have to be built and larger quantities of waste rock – especially sensitive in the case of sulphidic material that has the potential to generate acid drainages[2] – are generated (Bridge, 2004; Giurco et al., 2010; Mudd, 2010). For instance, recent studies conducted in the gold-mining sector in Australia indicate that, as ore quality decreases, the amount of water and energy used in the mining process increases significantly.

This trend overlaps with other environmental pressures, such as larger requirements of chemical inputs and larger amounts of waste (Mudd, 2007a, 2007b; Giurco et al., 2010; Prior et al., 2012).

The significance of these trends grows as we consider the expansion of the mining frontier to sensitive and critical ecosystems, such as tropical and cloud forests, or the very high mountains next to pasturelands and glaciers. These are also the homes of indigenous people. As pointed out by Bridge (2004), an increasing proportion of mineral exploration and investment expenditures during the 1990s targeted the tropical areas around the globe, reaching ecologically sensitive and/or high-value conservation areas. The International Union for Conservation of Nature (IUCN) has raised concerns related to the expansion of the mining, gas and oil frontier in World Heritage Sites, demanding protection for them (IUCN, 2011). Furthermore, recent studies led by scholars and activists are pointing to the large overlap of mining concessions with the land of peasants and indigenous people in Latin America (Bebbington, 2012b). For instance, de Echave (2009, quoted in Bebbington, 2012b) estimates that over half of Peruvian peasant communities are affected by mining projects or concessions. According to the EJOLT database (see below), in Latin America, indigenous peoples are present in over 50% of the environmental conflicts recorded to date in this registry (Pérez-Rincón, 2014). Chapter 11 on community consultations analyses in more detail some aspects of metal-mining conflicts in Latin America.

Moreover, it is important to stress that in the case of mining activities, ecoefficiency and technological approaches are limited. As the environmental impacts of mineral extraction can be reduced but not eliminated (Bridge, 2004), inputs to the mining process – such as water, energy or chemical compounds – can be reduced (per unit of production), the management of waste can be improved (e.g. better membranes to isolate waste from soil), and mining sites can be rehabilitated (e.g. revegetation). However, mineral mining necessarily modifies the environment to some degree. Moreover, operationalizing ecoefficiency in the mining sector is complicated by the fact that mining (unlike other industrial processes) is a segregative process that cannot avoid the production of large volumes of waste. This is increasingly significant considering the wider trends of declining ore qualities. Along the same vein, Giurco et al. (2010) maintain that mineral resource depletion is as much about falling resource quality (decreasing ores) and accessibility (distant and difficult to extract, with higher social and environmental costs and related conflicts) as it is about a reduction in resource quantity and availability. As follows, Prior and colleagues (2012) suggest that the "peak metal"

(the time when extraction can no longer rise to meet the demand) has more to do with a carefully weighed decision that considers the social and environmental implications of continuing to extract than a question of existing metal quantities available.

In early 2014, OCMAL, a network of organizations that records large-scale metal-mining conflicts, listed 203 active conflicts affecting 308 communities. According to OCMAL (2014), the largest number of mining conflicts are found in Peru (35), Chile (35), Argentina (26), Mexico (32), Brazil (20), Colombia (12), Bolivia (9) and Ecuador (7). Central America as a whole also has many mining conflicts. The impact of large-scale metal-mining activities on water, land, health, livelihoods and rights raises concerns among communities that feel disempowered by official decision-making procedures that place a premium on ecoefficiency and pecuniary criteria. Governments and mining companies frame complaints as being politically motivated and misinformed (Walter, 2014), but such a widespread wave of complaints (and so much violence against the protestors, at least in some countries) is evidence of a vigorous grassroots social movement.

Mineral fuels

This category includes a diversity of commodities, such as oil, natural gas and shale-gas fracking. We could also consider energy-related conflicts related to thermoelectricity plants. Oil is the main source of energy of modern societies; it is an essential input for the exosomatic energy metabolism of contemporary rich economies (transport, industry, etc.). The growth of the world economy has relied on fossil fuels over the last century, and the oil demand and consumption have increased steadily throughout the twentieth century. However, since the 1960s, there has been a decrease in the number of new discoveries of conventional oil reservoirs. Moreover, recent discoveries reveal decreasing quality, thus implying larger economic and environmental costs (Tsoskounoglou, Ayerides and Tritopoulou, 2008). As the pressure to find and extract conventional and unconventional fossil fuels augments, the frontiers of exploration and extraction expand, reaching environmental and socially sensitive locations.

One area in Latin America where the expansion of the oil-mining frontier has strongly impacted one of the culturally and biologically most diverse regions on Earth is in the Peruvian Amazon. Orta-Martínez and Finer (2010) indicate that since the 1920s, oil exploration and extraction in this region have threatened both biodiversity and indigenous peoples, particularly those living in voluntary isolation. They argue

that the phenomenon of peak oil, combined with rising demand and consumption, is pushing oil extraction into the most remote corners of the world. As modern patterns of production and consumption, and high oil prices, are forcing a new oil exploratory boom in the Peruvian Amazon, conflicts are spreading across indigenous territories, new forms of resistance appear, and indigenous political organizations are born. The expanding oil and gas frontiers are overlapping with the lands of indigenous peoples, some of whom were previously uncontacted, which fosters conflict, disease and unrest among these communities (Finer and Orta-Martínez, 2010; Orta-Martínez and Finer, 2010; Gavaldà, 2013).

An important case of struggle over the environmental injustices of oil extraction is in Lago Agrio, in the Ecuadorian Amazon. Between 1964 and 1992, Texaco's oil operations polluted the northern region of the Amazon forest in Ecuador, spanning 1 million Ha inhabited by various indigenous communities and resulting in environmental and health damage. Texaco was bought by Chevron in 2001. In 1993, local residents and indigenous communities filed a class-action lawsuit against Texaco in the District Court in New York for damages caused to their health and to the environment. For ten years the case was stalled in the US Courts, until 2003, when eventually the trial was moved to the Ecuadorian Amazon town of Lago Agrio. In 2011, in a landmark judgement, the local Sucumbios court sentenced Chevron Texaco to pay US$9.5 billion to the Frente de Defensa de la Amazonia, which would be doubled if the company did not publicly apologize. The court decision was upheld in 2012. Chevron has refused to pay and activists have tried to seize the company assets in third-party countries, such as Canada and Argentina.

Industrial and construction minerals

Industrial minerals include those used in industrial and agricultural processes. These minerals have different levels of toxicity and the pressures to extract them depend on their industrial uses. There are, for instance, conflicts related to the asbestos-mining in different places in Latin America. An example is the conflict of Sao Felix do Amianto in the state of Bahia (Brazil), which was open between 1939 and 1967 in the towns of Bom Jesus da Serra and Poçoes. There are many claims asking for compensation for health impacts, from workers both in the mine and in the factory.

There are also conflicts related to industrial minerals that are less toxic, such as phosphates. For instance, the Bayovar mine that is located in the north of Peru and is owned by Vale produces 5 million tonnes of phosphates per year (EJOLT, 2014).

Construction minerals are materials such as sand and gravel that are related to urbanization processes and infrastructure construction. These materials travel less than other materials because of their relatively low price per unit of weight, and for this reason they tend to be near the sites of processing and final use. As follows, conflicts over quarries are usually related to conflicts over processing plants (e.g. cement factories). An example of conflicts related to sand and gravel extraction is in Rio Tunjuelo (Bogotá, Colombia), one of the main sources of construction minerals in Bogotá. Some 50 years of extraction of sands and gravels have changed the urban landscape, shaping large holes in the ground. These holes are 30, 50 or 70 m deep and have diameters that reach several hundreds of metres. In 2002, in order to avoid the impact of a serious flood, old mining holes were used as water reservoirs to divert overflowing water from the Tunjuelo River. Flooded quarries became a source of infections and bad odours, as abandoned quarries became water oxidation ponds. Social unrest was born from the impact of abandoned quarries on water, and the environmental impacts related to the nearby processing plants. Another example is the conflict in San Juan Sacatepequez in Guatemala, where indigenous communities fostered a local consultation to stop the opening of a quarry and its processing plant on their lands. These activities were promoted by the national government without the consent of local inhabitants (EJOLT, 2014).

Conflicts at different points in the commodity chain

The classification presented here focuses on extractive activities, but conflicts can emerge at other stages of the life cycle of a commodity. In such a way, material extraction is connected to environmental and social pressures at different localities and to social groups that exceed the specific place where extraction is occurring. We point to four key stages related to the life cycle of a (raw material) commodity where conflicts emerge: extraction, transport, processing and final disposal.

First, conflicts can arise at the site of extraction. We have previously pointed out some of the socioenvironmental pressures and conflicts directly related to extraction.

Second, the transport of raw materials to processing plants is also related to noise, dust and air pollution. This stage also includes the impacts and conflicts related to the construction of transport infrastructures, such as pipelines and ports. An example of the tensions related to these activities is the Initiative for the Integration of the Regional Infrastructure of South America (IIRSA), led by a group of Latin

American governments with the support of the Interamerican Development Bank (IDB) and the Corporación Andina de Fomento (CAF). The IIRSA initiative aims to improve the connection of Latin American economies, connecting the Pacific and Atlantic oceans to facilitate the extraction and export of Latin American raw materials. It includes the construction of hydroways, gas and oil pipelines, ports and so forth. IIRSA-related projects are giving way to numerous large conflicts in the region (Svampa, 2012; Gavaldà, 2013), as these infrastructures are reaching the lands of distant communities that are also areas of high biodiversity and landscape value.

Third, processing plants usually require energy, water and chemical substances, and can also affect the quality of soil, air, and surface and underground waters, triggering health problems and social conflict. A paradigmatic case is La Oroya in Peru. La Oroya is a mining town in the Peruvian Andes that, since 1922, has been the site of a polymetallic smelter. This has produced toxic emissions and wastes from the plant. Recently the smelter was recycling scrap metals imported through El Callao (Lima's harbour) and taken up by railway to La Oroya, which has suffered from critical levels of air pollution and is considered to be one of the most polluted places on Earth (Blacksmith Institute, 2006). Owned by the Missouri-based Doe Run Corporation, the smelter was long signalled as responsible for the dangerously high lead levels found in children's blood.

Fourth, conflicts can arise when commodities reach the end of their life cycle and are discarded. Waste generation also includes impacts on soil, air and water generated during extraction, transport and processing (e.g. mining waste ponds and landfills). Climate change could be seen as a waste-disposal conflict because we have exceeded the capacity of new terrestrial vegetation and the oceans to absorb the carbon dioxide produced, and therefore its concentration in the atmosphere has increased to 402 ppm.

New approaches to studying environmental conflicts: A statistical political ecology

Since the 2000s, various groups have been creating online databases that register information on ongoing socioenvironmental conflicts in Latin America and beyond. These databases reflect an effort initiated by NGOs and social movements to make visible the increasing environmental injustices that communities confront. More recently, universities and research projects have also engaged in such systematization initiatives.

Some aim at mapping out environmental conflicts in one country, such as a recent inventory of over 80 conflicts in Colombia (Pérez-Rincón, 2014) and the Brazilian Mapa da Injustiça Ambiental e Saúde (Environmental Injustice and Health Map, by FIOCRUZ). In addition, there is a growing number of databases recording socioenvironmental conflicts throughout the region, including OLCA, and worldwide, such as our EJOLT project (Martinez-Alier et al., 2011). There are also databases focused on specific issues, such as tree plantations (see WRM), mining (OCMAL) and land-grabbing (Genetic Resources Action International (GRAIN)). Furthermore, there are important efforts being made to report on processes of protest and "criminalization" of activists or human rights violations in Latin America and the Caribbean (OCMAL, 2013; Toledo, Garrido and Barrera Bassols, 2013). This "criminalization of protest" refers to different processes that range from government officials and politicians who promote and apply laws that typify protest as unacceptable social behaviour and label protest as sabotage, terrorism or an obstruction of public space; to protesting organizations as illicit associations or publicly framing protestors as criminals (Saavedra, 2013); and, most dramatically, to the reality of countries such as Brazil, Mexico, Colombia and Peru, where environmental activists are being killed while defending livelihoods and nature (see the lists provided by Global Witness). The ENGOV project has created an inventory of Latin American databases and maps (available at www.engov.eu), while the global inventory by EJOLT allows us to analyse and compare different features of numerous extractive conflicts (available at www.ejatlas.org).

Conclusion

In this chapter we have explained the main trends in the social metabolism of Latin America and have focused on one of the main indicators, the material flows. In the last 40 years the extraction of materials has increased four-fold, far more than the population. A substantial part of the extracted materials (whether biomass, fossil fuels or metal ores, although not the building materials) goes to exports. We have developed a typology of conflicts according to the commodities in question. Many grassroots environmental organizations, and also academics and state bodies, are aware that there are more ecological distribution conflicts, and they contribute to environmental governance by making them visible through inventories and maps.

In regard to external trade and economic policies, we have insisted that at present most South American economies have large physical

trade deficits (in tonnes), and simultaneously they have or are about to have commercial trade deficits (in monetary terms). That is to say, the large physical exports that carry heavy ecological and social rucksacks are scarcely able to pay for the imports. In all of South America there are huge exports in volume (tonnes of oil, coal, iron ore, soyabeans, wood, copper, etc.) and yet several countries (Brazil, Colombia, Peru, Venezuela and Ecuador) have monetary commercial deficits. Remarkably, the recent "extractivist" trend happens both in countries with national-popular governments and in those with neoliberal governments. Even President Mujica of Uruguay favoured an iron-mining project with the Indian company Zamin Ferrous Metals in 2014. This project aims to export 18 million tonnes per year during the next 20 years – about 6 tonnes per inhabitant – leaving behind large environmental liabilities.

There are structurally unfavourable terms of trade for Latin American countries exporting natural resources. First, persistent physical trade deficits are recorded. We call it a "deficit" because natural resources are lost or depleted. In recent years, this trend has been accompanied by a monetary trade deficit that affects both small and large countries. Brazil had, between January and March of 2014, a trade deficit of US$6,072 million. This is the highest deficit for a quarter in 21 years, while Argentina has seen its monetary trade surplus sharply decrease between 2012 and the first quarter of 2014. Monetary trade deficits must be balanced by other income in the current account or in the capital account balance. The inflow of foreign direct investment can offset the trade deficit but it will generate income that will later leave the country. Increased indebtedness will lead to a need to export more and more, causing further environmental damage and social conflict.

While the demand for raw materials that are not recycled (e.g. fossil fuels) or only partly recycled (e.g. metals) is likely to remain over time, even without economic growth in the world system, the social and environmental costs of extraction are increasing as the grade of metallic minerals and the EROI decreases. This is the case as oil or gas is extracted from distant places, as also happens with timber, soy or palm oil. At the same time, even if in the long term the demands remain, prices can fall sharply due to variations in the business cycles. Overall, reprimarization is a risky economic strategy. Therefore, it is not surprising that new Latin American voices call for different economic policies. For them, the local complaints against extractive industries (including biomass extraction) should not be seen as instances of NIMBY ("not in my backyard") or as attacks on the state, but instead as useful contributions towards a change in environmental governance.

Therefore the criticism of South American post-extractivist scholars (Maristella Svampa, Eduardo Gudynas, Alberto Acosta) not only has a social and environmental basis but also has economic and democratic foundations. The export of raw materials depletes natural resources and causes pollution and conflicts with local populations. Governments use repression as a method to facilitate raw-material extraction. On the other hand, the prices of these major exports are cheap in comparison to imports, hence a new march along the route to debt. These tendencies point to the need for a change in policies. In fact, there have been some attempts to curb the export of raw materials through public policies such as the Yasuní-ITT initiative in Ecuador from 2007 to 2013, aimed at leaving oil in the ground under zones with exceptionally high biodiversity in the Ecuadorian Amazon. Popular resistance is also expressed in many existing protests, often arguing in terms of indigenous land rights. And new institutions arise as referenda or local consultations (see Chapter 11). These local protests and initiatives for environmental justice are a response to the power of corporations and governments, a power that leads to a deficit in local democracy. In sum, next to physical and monetary trade deficits, the export of raw materials also produces a deficit in local democracy.

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Notes

1. A recent industry study signals that, "With declining ore grades exacerbated by increasing energy and other costs, and significant deposits being found at greater depths or in more remote areas, the average capital costs for copper production capacity in new mines increased an average of 15% per year over the past 20 years, with much of the increase evident since 2008" (SNL Metals Economics Group, 2013).
2. Mining-related chemical pollution can be generated by the release into the environment of reagents added during mineral processing, such as the sulphuric acid that is used for the leaching of copper oxides, or the mercury or cyanide used to process gold. Pollution is also caused by the oxidation that naturally occurs in minerals that are present in the ore as a result of exposure to air, water and/or bacteria. Many metal ores, such as nickel, copper and lead, occur in the rock as sulphides. The contact with oxygen and water triggers an oxidation process that forms sulphuric acid. This process can result in the formation of acid rock drainages. This process has been pointed out as one

of the main environmental challenges of the mining industry (Bridge, 2004; Government of Australia, 2007; Giurco et al., 2010).

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3

Indigenous Knowledge in Mexico: Between Environmentalism and Rural Development

Mina Kleiche-Dray and Roland Waast

Introduction

Since the 1990s, several international agreements (Article 8J of the Biological Diversity Convention, 1992) and international protocols (Nagoya Protocol, 2010) have begun to assess the capacity of indigenous knowledge to contribute to socioeconomic progress as well as to environmental protection. In the course of this process, the knowledge and practices of peasants and natives have been called to the rescue to resolve a number of new problems. These include the loss of biodiversity, threats from carbon dioxide emissions and environmental conservation, with consequent debates about the property rights of local and autochthonous populations – such as that on "biopiracy" versus "bioprospection". However, the farming methods favoured by the indigenous populations often conflict with national development projects oriented towards the market economy. This discrepancy gives rise to tensions and to local, national and international conflicts that can be observed throughout Latin America. They are typified in a country such as Mexico, which will serve here as an example. Mexico has been the subject of a number of studies[1] and is often seen as a laboratory of both ideas and long-term development projects related to these issues. It has 12% of the biodiversity of the planet; natural vegetation occupies more than 71% of its territory, and its forest resources occupy 64.8 million Ha,[2] 70% of which belong to autochthonous and peasant communities (OCDE, 2013). Agriculture remains a highly important activity in the country, covering 24% of the territory (102 million Ha), of which half is *ejidataria* (communal land covered by extension services). Some

16 million of its 112 million inhabitants identify themselves as belonging to the *población indígena* and 7 million speak a native language. The population that lives in the areas of greatest biodiversity is generally classified as being one of the poorest. Some 88% of the 1,033 indigenous municipalities are classified as being in "great poverty". In fact, Mexico is the country that has the most revealing poverty rate in the OCDE.[3] Furthermore, its natural resources are deteriorating, under pressure from grazing, from slashing and burning brush in preparation for tillage, from excessive tillage and from intensive irrigation (OCDE, 2007). In this context, more and more social movements and proponents of environmental projects – such as the local branch of Vía Campesina – have emerged. They rely on autochthonous knowledge in the struggle against the rapid expansion of intensive agriculture, the monoculture of GM organisms, extensive ranching, biofuels, land-grabbing and extractive industries.

Of course, these social movements are by no means recent. However, everything indicates that they have gained a fresh impulse from the institutionalization of a national environmental policy, the boom of alternative rural development projects and the initiatives of new actors, such as movements of identity assertion and the national and international NGOs that support them (i.e. GRAIN).

These new actors favour decentralized management of natural resources, the setting up of local seed banks, the promotion of an agriculture free from chemical inputs, and the development of local markets. Family farming and small-scale agriculture – a political category that also covers the agricultural practices of the native and peasant populations – constitute the prime area targeted by their projects. In this complex context, "developmentalist" policies enter into competition with new projects classified as "socioenvironmental" (Léonard and Foyer, 2011).

New issues consist of the acknowledgement of indigenous and peasant knowledge, and its inclusion in the design, elaboration, implementation, execution and evaluation of projects that support family and small-scale agriculture.

Similarly, questions have arisen regarding ways of setting up a national environmental project that would involve native and peasant populations as well as new actors – NGOs, state and municipal authorities, and national and international private organizations (including large farmers and multinational firms) – in governance and decision-making. How can a sustainable and equitable use of natural resources be guaranteed? Is such an environmental project compatible with a particular development project?

This chapter focuses on the sociocognitive dynamics underlying the practical use of natural resources in family and small-scale agriculture. We shall first review the literature in social science studies and in Latin-American post-colonial studies on these dynamics. We shall then turn to the treatment of indigenous knowledge in mainstream social sciences and its promotion by certain policy-makers. Finally we will analyse the pragmatic combination of autochthonous and scientific knowledge in the process of governance, incorporating environmental matters by means of constant political, local and historical reconfiguration. These field perspectives are based on work in the Mixteca region (State of Oaxaca, Mexico).

Decolonizing indigenous and peasant knowledge

The objective of this chapter is to understand how, on the one hand, indigenous and peasant knowledge penetrates technoscientific knowledge and how, on the other hand, it becomes part of rural-development projects and environmental issues. Of major help in this attempt are the general concepts of "translation" (Callon and Latour, 1981; Akrich et al., 2006), "boundary-object" (Leigh Star and Griesemer, 1989; Trompette and Vinck, 2009) and "transcodification" (Lascoumes, 1994). They have been forged in the field of social studies of science in order to deal with similar problems (Callon, 1986 on scientists, fishermen and the plan to breed sea shells). These concepts postulate a continuity between the logics of knowledge production and political logics, and a centrality of the dynamics of translation and hybridization in different epistemic spheres (Harding, 1997). Social studies of science examine the mediations between knowledge of differing types (and especially between scientific and profane knowledge), and between scientific knowledge and the political logics involved in action.[4]

Meanwhile, the anthropology of local knowledge has analysed the categories grouped under the term "traditional knowledge". Agrawal (1995, 2002) points out the context of their use (and the political dimensions involved in asymmetrical exploitation of this knowledge compared with that of "scientific knowledge"), particularly in development projects. In regard to environmental issues, several authors have stressed the embedding of different types of knowledge in their conditions of production, their historical, social and institutional settings, and the need to study the full context of practices and circulation when they are put into operation (Fairhead and Leach, 2003; Goldman et al., 2011).[5] All these aspects have to be analysed if one is to understand exchanges

between types of knowledge and the construction of new hybridized forms in the processes of environmental governance. These various types of knowledge also have to be viewed in the asymmetrical perspective of North/South encounters (Gaillard et al., 1997; Escobar, 1995; Waast, 1996) and centre/periphery geopolitical relationships (Polanco, 1989; Raj, 2007).

Other useful perspectives have been developed over the last 15 years in Latin American post-colonial studies (Escobar, 2003; Boidin, 2010). Their Latin American proponents (e.g. in the Modernity/Coloniality/Decoloniality (M/C/D) programme, school of thought represented in Latin America) have catalysed a current of critical rethinking of "Eurocentric modernity". Using the notion of coloniality of power and of knowledge (Quijano, 1994; Lander, 2000; Mignolo, 2000; Dussel, 2007), the M/C/D programme describes colonization in a much more complex way, going beyond the conventional analysis in terms of political and economic oppression. A racial and ethnic classification of the world has given rise to a cultural oppression in which only one type of awareness and a single form of reason are taken into account. It is on this basis that geocultural identities have been attributed to the regions and populations of the world (Crespo, 2014).

The notion of "coloniality" reveals three parallel processes of "modernization": (1) the exclusion of other cultures or civilizations from participation in the construction of modernity; (2) the imposition of geocultural identities (Crespo, 2014); and (3) the exclusion of any forms of knowledge (other than the colonial) in the historical construction of the world. The M/C/D programme is an invitation to perform a "decolonial spin" (Castro Gomez and Grosfoguel, 2007) that involves taking into account the various places of enunciation and their critical or resistant approach towards colonial modernity. The programme uses the notion of "frontier epistemology" (Mignolo, 2007) to rewrite the narrative of modernity from alternative standpoints, re-evaluating dominated cultures and peoples and their histories of resistance. It aims, for instance, to retell the history of Latin America by taking into account relationships between society and nature.

The essential "coloniality of nature" in Latin America is linked to the disruption of indigenous ecosystems and methods of production, annulling the potential autonomy of these societies (Leff, 1986; Castro Herrera, 1996) and leading to a "subalternation" of the dominated bodies of both human beings and nature (Castro-Gómez, 2005). Arturo Escobar uses the concept of "nature regimes" to define the processes, articulating modes of perception and experience that determine the

ways of using space. These processes are identified as "resistance", "compromise" and "hybridization".

Taken up by political ecology, along with the notion of "colonized nature" (Escobar, 2011), this sort of thinking enables us to understand that the categories of "traditional knowledge" and "local knowledge" can only be grasped in opposition to that of "scientific knowledge". All knowledge is produced within social, political and economic relationships of certain types. And the actors who promote one or another type of knowledge in modern society always do so through a binary classification: modernity/coloniality or universality/pluriversality.

"Decolonizing nature" involves understanding, first and foremost, how "subaltern knowledge" has been identified and characterized by science – that is, disqualified, and sometimes reappropriated in downgraded form as a mere resource – and also the ways in which all actors relate to nature. Nature is not merely seen as a resource but in a different framework altogether: as culture.

From "traditional and local" to "indigenous" knowledge

This statement by A. Escobar leads us to examine the ways in which mainstream science has treated indigenous knowledge.

In the early 1980s, agronomists, in evaluating the technical component of farmers' agricultural practices, began to write about indigenous knowledge and know-how. The agronomists resumed observations and studies made by naturalists, ethnologists and linguists during and after the colonial period, focusing on instruments (tools), crop rotation, preparation of the land and so on. Within the social sciences, specialists in "development" subsequently took up the topic, accompanied by a few anthropologists.[6] This eventually muted into a craze, despite the fact that level-headed specialists stressed that local knowledge should not be made into a fetish.

In the 1990s the notion moved from agricultural questions to environmental studies, passing from issues of production and productivity to those of conservation and the management of natural resources. It came to the attention of experts, research centres and international organizations (Bell, 1979; Chambers, 1988). Many anthropologists climbed on the bandwagon. Their intervention opened up two distinct perspectives. On the one hand, the majority supported recognition of traditional knowledge, as it represented for them – at the very least – new fields of study, new sources of finance for applied anthropology, and access to a "specialist" status. On the other hand,

the term "indigenous knowledge" began to develop as a more militant concept, highlighting the dependence and marginalization of "indigenous" peoples. This latter term differs from the previously predominant notions of "traditional" and "local knowledge", which have now come to be seen as condescending. The former term is linked to a modernizing project for society, and the latter to the universality of "scientific knowledge". These two notions enabled that of "indigenous knowledge" to emerge as a relatively open-minded alternative. Its promoters stressed that indigenous knowledge cannot be reduced to a recipe for development (Agrawal, 1995; Sillitoe, 1998). The notion of "indigenous knowledge" has been instrumental to the recognition of local knowledge in the legal field, in that of intellectual property rights and more generally in the right of peoples to their own culture.

Work on this subject continued to develop in the 2000s, massively appropriated in environmental studies and anthropology. In these circles, there has been passionate debate on the subject. The arguments deployed have often helped "indigenous" peoples and peasants to obtain the benefits brought about by development as well as greater political autonomy.[7] The journal *Human Ecology* has become a major vector of this environmental and anthropological work.[8] The notion of "traditional knowledge" has since followed its own developmental path, with a strong environmental focus. Many authors use the two concepts – traditional and indigenous – interchangeably (Godoy et al., 2005).

As for Latin America, the local history of all these notions is not very different. The term "indigenous knowledge" appeared very early on and spread primarily through Brazil, Mexico, Bolivia and Chile. Interestingly, it eventually deserted scientific literature and was linked mainly to social movements. At present there are few studies published on the topic in the social sciences and humanities. Possibly the recognition of intellectual property rights after the Rio Conference in 1992 put an end to debate in the region.[9]

Very few studies deal with the way in which companies avoid complex negotiations with local communities – buying, for example, medicinal plants on local markets, and hiring and training collectors and growers of plants required for natural cosmetics. Likewise, few authors now undertake studies of traditional knowledge in regard to medicinal plants, experiments with traditional knowledge in public health services, and discussions about climate change and other current issues.

While the term "indigenous knowledge" has been fading out, that of "agroecology" has grown in popularity, especially in Latin America. Agroecology as a scientific field valorizes native and peasant farming

practices as a socioproductive alternative to modern agriculture (Altieri et al., 2006) that is also environmentally friendly. According to its protagonists, native and peasant practices can inspire the ecological scientific approach and at the same time become a sustainable way of farming.

Scientific and institutional interest in indigenous and peasant farming practices is not really new, however. In Mexico, a key figure in this intellectual tradition was Efraim Hernandez Xolocotzi (known as Efraim H.X.), an agronomist who was educated in the USA and taught at the University of Chapingo. He was called back to Mexico to support the Green Revolution at its very beginning but soon became critical of it (Jiménez Sánchez, 1984). He contributed to the creation of an agroecological movement in Mexico. Basically, his objective was to show how important it was to study traditional agrosystems, stressing the fact that resource scarcity drives man's creativity and encourages him to develop a set of cultural and productive practices to adapt to the environment and to the conditions of production (Díaz León and Cruz León, 1998). According to Efraim H.X. and his disciples, especially Victor Toledo (1992), "the indigenous model" of agriculture can serve as a basis for the development of agroecological knowledge and practices. In the 1980s a socialist current in Mexico – consisting primarily of biologists, ethnobotanists and agronomists – joined in social and environmental thinking and engaged directly with native and peasant communities.

Agroecology has been politicized in different ways for different purposes, depending on whether it is being promoted by academic activists, by peasants, by religious militants, by agronomy advisors or by officials. This can be said about projects ranging from the design of public policies to initiatives of an extremely local nature. This is what we will now discuss, tracing this shift in the political field and, in particular, in public rural development policies aimed at small-scale family farming.

Indigenous knowledge as a lever for rural development and environmental policies

After a period of liberalization of structural adaptation plans following the financial crisis of 1982 – which resulted in the ratification of the North American Free Trade Agreement (NAFTA) and the political and financial crisis of 1994–2005 – Mexican agriculture had to face international competition in a context of market deregulation and trade liberalization. A policy of food security[10] replaced that of food self-sufficiency, which had been the credo of agrarian reform and the Green Revolution. By the 1990s the *ejidos* had been privatized and extension

services reduced. As a result, foreign purchases of foodstuffs increased (Warman, 2001).[11]

Nevertheless, political discourse has continued to defend the importance of developing autonomous and efficient agrifood systems. In a country where only 6% of farmers are classified as "modern",[12] the Mexican Government has had to propose various programmes and measures to mitigate the impacts of rising food prices for the poorest strata of the population (Gravel, 2009). The main measures aimed at the poorest farmers were a distribution of grants according to cultivated acreage (such as the so-called Procampo Programme) and aid to the poorest women (Progresa/Oportunidad). The less marginalized categories were urged to adopt the Green Revolution technology package (hybrids, fertilizers, pesticides and mechanization) in programmes such as Object Income and Masagro.

Thus in 2007 the state designed a new national policy for rural development as a whole. With the programme *Nuevo Programa Especial Concurrente* (PEC), the government began to take an interest in the integration of the native and peasant population into national development. This PEC was launched in areas of great and very great marginalization, the population itself taking part, thanks to the organization of a forum (*Foro de Consulta Popular*), to which all stakeholders in the rural sector were invited.[13]

However, only 15.7% of all financial resources considered in the PEC were directed towards the support of agricultural food production (Gomez-Oliver, 2008). Furthermore, programmes that targeted small farmers – either by distributing a technology package or by granting subsidies – encouraged deforestation, and this gave rise to further intensification of farming.

This seems to be at odds with the aim of developing a national environmental policy. Yet ratification of the Convention on Biological Diversity and recognition of native struggles (in the San Andrés agreements of 1994) finally led to the creation of the Environment Ministry (the Secretariat of the Environment and Natural Resources/Secretaria de Medio Ambinete y Recursos Naturales (SEMARNAT)) in 1994. An environmental policy that attempts to integrate the international standards of Agenda 21[14] was established. In 2000 a National Plan for Sustainable Development was adopted. To top it off, in 2000 the Mexican Constitution was changed so as to acknowledge the cultural and ethnic diversity of Mexican society. This particular interest has been reinforced since 2007 in the sustainable development programmes in which ecological viability is treated as one of the five cornerstones of federal action. This functions in tandem with the Sector Programme for the Environment

and Natural Resources, the objective of which is to "associate the conservation of natural capital with economic and social development" (OCDE, 2013: 40). The dual process involved in the recognition of indigenous knowledge has thus been made part of the development pattern for agricultural and environmental policies.

In this dual ministerial context, the Mexican Government undertook the task of integrating the participation of the native and peasant population into its agricultural policy and also into its political agenda, thereby institutionalizing national environmental policy.

The Ministry of the Environment has confirmed that "the native populations that maintain a very close link with natural resources and biodiversity actively support sustainable development through on-site conservation of ecosystems and natural habitats, and the maintenance and recuperation of viable populations of species in their natural surroundings".[15]

In 1997 the Ministry of the Environment initiated the Conservation and Restoration Programme of soils. In 1998 it launched the National Reforestation Programme and other programmes that sought to combine economic and social development with environmental conservation. The objective was to devote economic resources to National Protected Areas and to the restoration of regions identified as priorities from an environmental perspective.

The main tools that the government has used have always been aimed at the conservation of biodiversity and of forests, in accordance with the National Strategy for Biodiversity (2000), complemented by the Mexican Strategy for the Conservation of Plants (which has existed since 2008 and was revised in 2012) and subsequently enhanced by the National Strategy combating invasive species. Major programmes within this framework have been specifically dedicated to native and peasant populations.

A twist was introduced, however, when the Ministry of the Environment developed its Regional Sustainable Development Programme (*Programa de Desarrollo Regional Sustentable* (PRODERS)) in an attempt to link the environmentalist vision to a developmentalist one. The programme was presented as a comprehensive initiative by means of which SEMARNAT contributed to the support of sustainable development in poor rural regions. These regions often include native and peasant populations who live where the major biological and environmental riches are located, far from the rural nodes. The management of this programme was supposed to be decentralized and participative, based on a long-term vision (Toledo and Bartra, 2000).

Thus it would seem that – despite almost ten years of government efforts to institutionalize an environmental policy linked to the development of sustainable agriculture in the most disadvantaged areas of the country – most observers agree that the main thrust of agricultural policy has been, and remains, the pursuit of greater productivity (OCDE, 2013). The bulk of financial resources are still being oriented towards commercial agriculture and "modern farmers": the most important subjects in the sector. This conclusion is congruent with the criticism emanating from the post-colonial school, which interprets from these policies a vision based on denial of all rationality and veritable knowledge in other forms of culture. This attitude does not leave room for any concepts other than those of a modernizing society and its links to high-productivity projects. Ultimately, it leaves no space for plurality or, in the words of Arturo Escobar, "pluriversity" (Escobar, 2011). Although this trend presents itself globally, the fact remains that conflicting logics – even at a government level – mean that heterogeneous projects are now being implemented for merely practical reasons. Several studies have attempted to bring visibility to the success of various local experiences that overcome this contradiction between developmental and environmental concerns. The government – notably two ministries (Environment and Agriculture: SEMARNAT and SAGARPA (*Secretaria de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación*)) – gave direct or indirect support to these local experiences, particularly (a recent development) various civil society groups that had made progress in the conservation of soil and water, the protection of biodiversity and wildlife, and the autonomy of their food systems. We shall now describe a case of this sort that illustrates the importance of practical reason in action.

Towards an institutionalization of native and peasant knowledge

We will now deal with a case study that needs to be contextualized. Its whole story takes place in the Mixteca Region of Oaxaca, Mexico. To begin, we will discuss traditional knowledge and its evolution over the course of time.

Construction of agricultural knowledge and practices, and their exchange over the course of time

The Mixteca region of south-east Mexico covers the eastern part of Oaxaca state. It extends over an area of 4 million Ha, in which there are

221 municipalities, 155 of them located in the state of Oaxaca. It is in the Mixteca region that the largest "indigenous population" of Mexico is concentrated, with more than 1 million people (34% of the Oaxaca population)[16] (INEGI, 2010). *Mixtec* inhabitants belong, however, to a diversity of peoples: Chocholteca, Tlapaneca, Nahuatl, Triqui, Zapotec and Amuzgo (Rivas Guevara et al., 2009). Their history is traversed by episodes of expropriation and reappropriation of their land.

The Aztecs and later the Spanish colonized the region and divided local political entities into small communities, grabbing the best land. Since the Mexican independence, the Agricultural Reform has redistributed the *haciendas* (large farming units) into *ejidos*, the privatization of which has been authorized by federal law since the 1990s. The result has been a broad diversity of land use and tenure in the native and peasant communities of the *Mixteca – bienes comunales* (commons), *ejidos* (public lands with extension services), *tierras de uso común* (collective lands managed by means of community meetings) and *tierras privadas* (private lands). Control is highly concentrated: 1.7% of the *ejidos* and communities control 70% of the land, and 0.41% of the private properties cover 20% of the total of privatized lands. Thus more than 85% of private units and *ejidos* are smaller than 5 Ha (Sanchez Lopez, 2013). This inequality has generated agrarian conflicts that continue to this very day.

However, despite this conflict-ridden history, periods of tranquillity have made it possible to introduce new plants, and new techniques of cultivation and food preparation, since colonization. This has been due to exchanges among communities during religious festivals and at markets, and migration to other regions (Katz, 1994, 2002). During the colonial period, the cultivation of wheat and sugarcane, extensive ranching, and the breeding of silkworms and cochineal progressed, gaining economic importance (Long and Attolini, 2009; Lazos, 2012). With the decline of the silk industry and cochineal at the end of the nineteenth century, artisanal palm weaving gained importance, driven primarily by the Spaniards, who managed to establish an international market. On the other hand, deforestation and the erosion of soils worsened when goats were introduced and lime was exploited (Velásquez, 2002).

Subsequently the Mexican Government's "developmentalist" project also had an impact on these dynamics, by influencing local agricultural practices. From 1935 to 1988, the Mexican Government implemented more than 19 "developmentalist" programmes (Altieri et al., 2006) dedicated to crops ranging from cochineal, fruit trees, coffee, hybrid corn,

and vegetables to livestock and the improvement of agricultural infrastructure. During the 1970s the government also tried to promote a Green Revolution technology package (improved seeds, mechanization, the use of fertilizers and chemical pesticides) by means of aids and extension services within the framework of its Integrated Rural Development Programme (*Programa Integral de Desarrollo Rural* (PIDER)). Though PIDER achieved a significant volume of production, it led to the loss of native varieties of maize, beans and squash; the contamination of soil and water; the overexploitation of aquifers; deforestation; and soil erosion (Altieri et al., 2006).

The government saw the main problems of the Mixteca as matters of water and soil. By the 1970s, it tried to recover the Mixtecan technique of terraced agriculture that the inhabitants had lost (Mendoza García, 2002, 2004). This had been used in small valleys and heavy rainfall areas. The federal government attempted to restore the ancient terraces using heavy machinery. Facing poor results, it decreed that the Mixteca was unable to sustain the development of an alimentary agriculture. The main replacement project was to plant palm trees to supply a craft industry. As of 1973, weavers were organized into cooperatives (Velasco Rodriguez, 1994) supported by the Palm Trust (Fideicomiso de la Palma (FIDEPAL)). Unfortunately, the government neither managed to consolidate this cottage industry nor to diversify the uses of woven palm fibre. Marketing, support for cultivation, the development and exploitation of palm plantations, and the industrialization and export of goods made from natural fibres all disappeared during the 1990s.

Despite these setbacks, today in the Mixteca, small-scale and family farming cover areas larger than in other Mexican regions. Some 30 years ago, most of the Mixtec population was involved in agriculture. But migration has had a profound impact – especially since the 1990s, which saw extensive migration to the United States. Emigration now accounts for more than 30% of the population (Lazos, 2012). This has weakened local institutions considerably, including mutual aid, collective work (such as the *guetza* and *tequio*)[17] and social networks. The *milpa* – the food and agriculture system, associating representations and rituals with the cultivation of maize, beans and squash – seems to subsist only in homes that need fresh maize for the festivities of the Day of the Dead, which maintain a symbolic link with the land (Lazos, 2012). All the varieties of maize that needed a lot of work and a lot of space have gradually been abandoned and replaced by commercial crops, such as passion fruit and new varieties of tomatoes that are grown in gardens and greenhouses[18] (Katz, 1994). Today the farming system has to

be complemented by additional income from welfare programmes and remittances sent by emigrant relatives. Thus the native and peasant population tends, on the one hand, to diversify their diet by buying more meat and industrial food and beverages; on the other hand, they consume fewer of the wild greens (*quelites*) that were always seen as "poor people's food" (Katz, 1992).

The "farmer to farmer" model in the Mixteca region (Oaxaca state)

Life is difficult, and modernity, cash crops and intensive technology are attractive; but there are alternatives. Our case study accounts for a civil society group (*Centro de Estudios de Tecnologías Alternativas para México*/Center for the Study of Appropriate Technologies for Mexico (CETAMEX)) and the institution that was finally built by its efforts. Institutions of this sort were set up with the support of the government, although sometimes the support was indirect, as in the case of the Center for Comprehensive Peasant Development in the Mixteca (*Centro de Desarrollo Integral Campesino de la Mixteca* (CEDICAM)).

The CETAMEX group has roots in the vast experience of the team that worked with civil society in the Mixteca Alta from 1983 to 1997. CETAMEX (headquartered in Mexico, DF) is financed by the World Neighbors organization (*Vecinos Mundiales*), whose objective is to resolve internal community conflicts by means of collective work performed for the benefits of the community (Blauert, 1990). World Neighbors is a Protestant religious organization that comes from Oklahoma. It formed links with a Catholic movement, *Pastoral de la Tierra*, which emerged in indigenous and peasant communities in the Mixteca region of the state of Oaxaca in the 1980s, with the help of Guatemalan peasants who were there on missionary service for World Neighbors organization.

Thanks to the advice and support of these Guatemalan peasants, catechists of *Pastoral de la Tierra* as agricultural development promoters (Holz-Giménez, 2006) – who also gave agricultural advice derived from their own peasant experience – and the technology support of people from CETAMEX, a project was launched in Santiago Tilantongo (a Mixtecan municipality) by Jesús León Santos, a local farmer.[19] This was in the early 1980s, and Santos and his colleagues received some funding from World Neighbors (Blauert and Quintanar, 2000). They decided to adopt the strategy of the World Neighbors movement (i.e. to work only with local authorities and to avoid direct dealings with federal government agencies (Bunch, 1985)) and to build up farmer-to-farmer networks (*campesino a campesino*), which focused on

improving native and peasant farming practices (Boege and Carranza, 2009; Holt-Giménez, 2010).

Initially the "parent group" of CETAMEX provided services that were instrumental to promoting the use of organic fertilizers, reforestation, and the construction of tree nurseries in the municipalities of Yodocono and Tilantongo by 1982 (Altieri et al., 2006). Jesús León Santos and his colleagues subsequently worked in different municipalities and in nine communities (Nochtixltan and neighbouring communities) of Mixteca Alta. They restored the fertility of the soil when the surface layer was exposed to the effects of agents of erosion (air, water and anthropogenic activity). They made fundamental contributions to the recovery of the *tequio* (*yeta* or *guetza*), to mutual aid and to collaborative organization of work. They also recovered several techniques such as *barbecho* (long-fallow land), *recorte* (delumping), *rayada* (planting in rows), *cajeteada* (planting corn or cornfields in pits or bowls), *coa (*plowing), *yunta* (the yoke) and other local devices that retained moisture and prevented soil compaction. Subsequently, to improve the soil, they used green manures (*bocashi*) and selected their own seeds. They dug trenches on field borders and on slopes of land, forming terraces to prevent erosion, to maintain moisture and to revive springs (Rivas Guevara, 2008; Rivas Guevara et al., 2009). As a first step they undertook reforestation, using local tree species that could generate firewood, timber and wood for crafts, and they created a new organization of community nurseries.

Their second step was to restore the cultivation of *maices de cajete* by accumulating in ravines a water supply and the *limon* that had been swept away by landslides. This system (known as *jollas*) makes it possible to use residual soil moisture at the end of the rainy season to plant *maices* and thus avoid a hunger gap by guaranteeing a full year's harvest of maize. The *jollas* system was created by the Mixtecs between the pre-classical and the post-classical ages in response to demographic pressure (Romero Frizzi, 1990); until the 1980s it functioned in the sub-region of the Mixteca Alta (in the Nochixtlan, Tiaxiaco, Teposcolula and Coixtlehuaca districts). At the time, this crop system was the second most important in the Oaxacan Mixteca (Romero Penaloza et al., 1986).

It is worth noting that, in a region where *tequio* and/or the *guetza* had often been abandoned, the conservation and restoration of soil and water required intensive labour.

Fortunately, the Ministry of the Environment became concerned with soil erosion, and subsequently the government launched a national programme for soil conservation (PRODERS). This included a specific project (ProArbol) that benefited CETAMEX. Free, adapted trees were

distributed, enabling the CETAMEX members to save time and labour and to concentrate on agrifood systems.

Major institutions, such as the General Directorate of Regional Programmes, were established to harmonize the programmes of different ministries. This was notably instrumental in bringing together the three ministries of the Environment, Agriculture and Social Development in support of the Sustainable Productive Development in Marginal Rural Areas (*Programa de Desarrollo Productivo Sustentable en Zonas Marginadas Rurales* (PDPSZRM)) programme. In the late 1990s, this programme, supervised by eight secretariats, implemented about 50 regional projects. The community was considered to be the basic territorial unit within Regional Development Councils (which brought together institutional and civil-society actors in prioritized microregions). These councils had to design and implement development plans whenever involvement of the community was needed. PRODERS also organized local workshops for training and for developing new skills in communities.

In 1989 a new institution was created in the Mixtec region itself: CEDICAM. This brings us back to the beginning of our story: that of a peasant movement (CETAMEX, see above). CEDICAM (*Hita Nuni* in the Mixtec language) is based in Asuncion Nochixtlan. Its role is to promote the "farmer to farmer" relationships by means of workshops and educational demonstrations. It consists of 12 Mixtec farmers who have qualified as demonstrators in the 14 Tilantongo communities. Jesús León Santos is one of the founding members of CEDICAM. He is also in charge of networking with support agencies, including Mexican governmental programmes. Santos argues that care for water and soil are essential for sustainable agriculture (Velásquez Hernández and Santos, 2006).

Finally, the pioneers who were involved in the beginnings of the CETAMEX farmers' group have recovered both their agricultural practices and a balanced diet. Others are following the same path, but this is not why they have been praised throughout the world. What is admired, above all, is their contribution to ecology (conservation of soil and water, and reforestation). In 2008 their main representative, Jesús León Santos, was awarded the annual international Goldman Environmental Prize in recognition of their efforts. Santos embodies the success of traditional peasant and indigenous agricultural practices in combating desertification. He has spread the word to all arenas in which the environment is an issue of concern.

Several experiments of this type (see Chapter 10) have shown that the initiatives of communities themselves, supported by civil-society

associations, constitute a warning call to governments. The governments, in turn, rely on these institutions to design and implement appropriate programmes. One of the most important actions in this programme, which has made Mexico an international model, is the National Programme for Payment of Environmental Services (PES), which covers 3.25 million Ha of forest. The ProArbol Programme establishes the principle of financial compensation for all actions that retard deforestation and promote the recovery of forest soils.

The teachings that have brought the Mexican experience into the limelight concern potentials and limits of projects that are "truly alternative", and which at some point need to rely on the state's capacity for action. In a way, this shows that nothing can be done without the state, but that with only state support nothing can be done at all.

Conclusion

In Mexico the issue of environmental governance is linked to that of social and economic development by its explicit objective: "food sovereignty". We have examined this relationship at different levels – national, regional and local – and we have found that effective environmental governance calls for a simultaneous analysis of Mexican agricultural policy as a whole, including the "traditional" practices of the native and peasant world. Moreover, our analyses have been diachronic as well as synchronic, and historical as well as structural. Their aim is to clarify, identify and characterize economic trends and the ways in which different sorts of knowledge contribute to this aim, by their interplay in the process of constructing environmental standards.

We have described the construction of environmental governance in the Mixteca region in Mexico, which is home to numerous native and small-scale peasant communities, known for both its food requirements and its exemplary efforts in reforestation over the past 30 years. The environmental governance process has been worked out here in terms of participation. In practice this implies the integration, accommodation and hybridization of traditional native and peasant knowledge. How do these different sorts of knowledge fit in with knowledge of the modern technoscientific sort? We have attempted to unpack the intellectual framework involved and the steps through which the process passes. We have relied on a theoretical framework that involves both science and technology studies (STS) and post-colonial studies (with its Latin American version, the M/C/D Programme). We have explained that a historical trend has assigned a subordinate place to

indigenous knowledge; but also that, for practical reasons, it is translated and exchanged when it is acted upon. Exchanges can be structural (e.g. in the Green Revolution) or merely circumstantial (e.g. in the course of colonization). They can also take place between different agricultural communities that have different types of knowledge. Since ancient times, market places have been the locus of an exchange of plants (and the ways to grow them) – that is, for an exchange, adaptation and transposition of knowledge brought in from abroad. Native and peasant knowledge is not fixed; it evolves, just as technoscientific knowledge does. "Pre-modern" knowledge has now come to inspire a number of academic works, and has also influenced technical and ecological thinking. Attention has been drawn to it, and it itself has become an object of knowledge. We have shown that this upsurge of scientists' interest has been aligned with the policy debates of the day, in such matters as technology and agriculture, ecology and the environment, and cultural and social issues. There is now in Mexico an agroecological approach that is recognized by the academy and that is used by technical operators.

All of this has drawn attention to the weight of practical considerations in the evolution and reception of different sorts of knowledge, including scientific knowledge. Practical reasons not only spur a few dissident approaches but also orient the action of farmers and governments. We have dealt, to some extent, with the case of a local initiative promoted by native and small-holding farmers. They began by resisting the options and programmes designed for them by the Ministry of Agriculture, but subsequently attempted to gain self-sufficiency by restoring their traditional collaboration and recovering discontinued agricultural techniques. In doing so they have contributed to the conservation of soils and wooded areas, and this in turn has brought them recognition and help from the Ministry of the Environment. Action can change perspectives, with some actors learning to see others in new ways and opening up opportunities to build alternative projects through interaction with partners who had not originally been envisaged.

To what extent can autochthonous and peasant populations seize such opportunities, which are generally based on "secondary contradictions"? The answer to this question is less clear. There are many contradictions between environmental and agricultural policy. There is, however, a dominant trend. In Mexico it would seem that (intensive) agriculture has gained the upper hand. But this does not prevent other concerns (social and environmental) from being asserted. There has

been a focus on environmental protection through reforestation. Reforestation programmes have fostered the creation of opportunities for participation at a microregional level, complementing policies dedicated to nature reserves and support for community initiatives. Simultaneously, however, the "productivist" agricultural programme designed for marginal areas (*Procampo*) has been repeated (at least for 2007–2012), despite the fact that is has accentuated deforestation. History shows also that state support, direct or indirect, is necessary for small-scale initiatives to blossom, if not during their take-off period then at least for their subsequent development and replication in other regions. Unfortunately, today there is a downward trend in budgets dedicated to environmental protection and rural development.[20] This makes new local initiatives even more precarious.

Therefore, despite the number of programmes that have been devoted to marginalized populations over the last ten years, the National Strategy seems to lack an overall plan of action. What direction will this policy take? How will it take into account the multiple experiments that have been carried out in the more vulnerable and marginalized regions?

Similar contradictions exist at an international level. The Biodiversity Convention made a breakthrough when it obtained the FAO's agreement on phytogenetic resources, recognizing that autochthonous peoples owned pro parte biodiversity and its uses. But its implementation is still in question. It is true, furthermore, that recognition of the important part played by peasant and indigenous family agriculture (providing 70% of the global food production; the FAO dedicated the year 2014 to this sector) could have a leveraging effect in promoting an operational recognition of native and peasant knowledge. However, few people argue that it would be enough to feed the planet, to alleviate dramatic famines throughout the world and to supply large cities. This is what accounts for the dual system that exists today, and what legitimates the pursuit of other avenues of (scientific) research. For example, another Mexican citizen, Dr Sanjaya Rajaram, won a World Food Prize in 2014 for his work on the genetic improvement of maize, thanks to biotechnology.[21]

At the preparatory meetings of the international climate conference (COP21), held in Paris at the end of 2015, a wish was expressed: to combine concern for family and peasant farming with thinking about climate change. It is yet to be seen whether the international conference will provide native and peasant knowledge with a real opportunity to contribute to the construction of policies dealing with climate issues.

Notes

1. Notably, studies of WP5 "Building and Exchanging Knowledges on Natural Resources in Latin America" within the ENGOV EU Programme.
2. Forests occupy 33% of the territory with 200,000 different species, which puts it in 12th place internationally, 2nd place in terms of variety of ecosystems and 4th in terms for species (OCDE, 2013).
3. It also appears in 12th place of the countries with the greatest inequality in terms of income.
4. Until now they have dealt little with specific mediations in agriculture projects, especially between scientific knowledge and native or peasant knowledge.
5. This analysis is detailed in Foyer et al. (2014).
6. The works in this field are abundant. We primarily cite Howes and Chambers (1979); Howes (1979); and O'Keefe and Howes (1979).
7. See the Waast and Rossi report (2014). The most cited works are Davis and Wagner (2003); Woods (2002); Greene (2004); and Turner, Davidson-Hunt and O'Flaherty (2003), cited in Waast and Rossi (2014).
8. See Hassink (2005); Berkes and Turner (2006); Godoy et al. (2005); Greene (2004); Aswani and Lauer (2006); and Kirsch (2001), cited in Waast and Rossi (2014).
9. The issue was resumed in Mexico after the controversy surrounding the International Cooperative Biodiversity Group-Maya (ICBG-MAYA) project in 2000: on the one hand it was denounced as "biopiracy" and on the other hand it was advocated as a development project respectful of local communities. See Alarcón Lavín (2011); see also Barreda (2001).
10. Food security is related to the healthy diet of a maximum of persons all over the world. Perhaps the social and indigenous movement forged the food sovereignty movement, which means that each group of people should design its own agriculture policy according to its needs and culture.
11. It has been observed that imports increased from 74% to 84% for oil, from 22% to 40% for cereals, from 18% to 27% for meat, and from 15% to 24% for milk. Despite the great proportion of the population linked to agriculture, Mexico has become one of the main import countries of agricultural products (in third place after the EU and Japan).
12. In other words, with sufficient capacity to integrate into the market. See Gravel (2009).
13. Seven regional forums of public consultation – coordinated by the Interministerial Commission for Sustainable Rural Development (*Comisión Intersecretarial para el Desarrollo Rural Sustentable* (CIDRS)) – were created with the objective of collecting the proposals and viewpoints of the rural population on five topics, among which were nutrition, welfare and care for the environment.
14. It was initially created as the Ministry of the Environment, Natural Resources and Fishing (Semamap) in 1994, but it later became the Ministry of the Environment and Natural Resources. Today, climate change is included within the transformation of the agency, changing the National Institute of Ecology (INE) into the National Institute of Ecology and Climate Change (INECC). The National Commission on Biodiversity (CONABIO) and the

reformulation and strengthening of the General Law of Ecological Equilibrium and Environmental Protection (LGEEPA, 1996) are also included. See Léonard and Foyer (2011).

15. The fundamental initiative in this regard is the Indigenous Peoples and Environmental Programme 2007–2012. See SEMARNAT, México, 2009, http://www.semarnat.gob.mx/apoyossubsidios/programmeasparalospueblosindigenas/Documents/programprogrammemea%20de%20pueblos%20indigenas%20y%20medio%20ambiente.pdf, date accessed 15 September 2014.
16. Population in Oaxaca State, 3.8 million (INEGI, 2010).
17. Flores Quintero, G. (2005) has clarified what differentiates *guetza* from *tequio*. In effect, despite what had been written, it has been shown that *guetza* is the collective work that was institutionalized during the colonial era. *Tequio* is a náhuatl word that designates the community service of the adult members of the community, whose origin dates back to colonial times.
18. Esther Katz has observed how, in the last 30 years, the variety of cultivated species has diminished considerably. This is the case for the maize of the humid highlands. See Katz and Kleiche (2013).
19. Olga Elena Lara, interview with Jesus Santos León, http://sshelitonimages.com/play/ptk9uDK0XuU/Part_1 (date accessed 15 September 2014).
20. By 2011 the budget of SAGARPA was 73 billion Mexican pesos, while the budget for the environment fell to 51.2 billion Mexican pesos (out of which 12.6% was for marginalized areas: 0.99 billion Mexican pesos went to the Comisión Nacional de Áreas Naturales Protegidas (CONANP) versus 3.35 billion Mexican pesos in 2002) and 6.42 billion Mexican pesos to the Comisión Nacional Forestal (CONAFOR) (OCDE, 2013).
21. Dr Sanjaya Rajaram belongs to Centro Internacional de Mejoramiento de Maíz y Trigo (CIMMYT), an organization that played a key role in the Green Revolution of the 1960s.

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Part II
New Politics of Natural Resources