

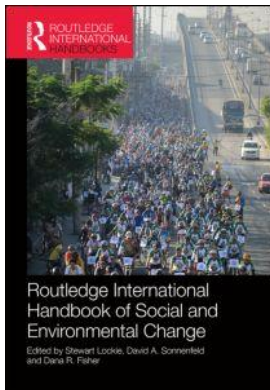
This article was downloaded by: 10.3.98.104

On: 19 Oct 2020

Access details: *subscription number*

Publisher: *Routledge*

Informa Ltd Registered in England and Wales Registered Number: 1072954 Registered office: 5 Howick Place, London SW1P 1WG, UK



Routledge International Handbook of Social and Environmental Change

Stewart Lockie, David A. Sonnenfeld, Dana R. Fisher

The emergence of new world-systems perspectives on global environmental change

Publication details

<https://www.routledgehandbooks.com/doi/10.4324/9780203814550.ch3>

Andrew K. Jorgenson, Jennifer E. Givens

Published online on: 31 Oct 2013

How to cite :- Andrew K. Jorgenson, Jennifer E. Givens. 31 Oct 2013, *The emergence of new world-systems perspectives on global environmental change from*: Routledge International Handbook of Social and Environmental Change Routledge

Accessed on: 19 Oct 2020

<https://www.routledgehandbooks.com/doi/10.4324/9780203814550.ch3>

PLEASE SCROLL DOWN FOR DOCUMENT

Full terms and conditions of use: <https://www.routledgehandbooks.com/legal-notices/terms>

This Document PDF may be used for research, teaching and private study purposes. Any substantial or systematic reproductions, re-distribution, re-selling, loan or sub-licensing, systematic supply or distribution in any form to anyone is expressly forbidden.

The publisher does not give any warranty express or implied or make any representation that the contents will be complete or accurate or up to date. The publisher shall not be liable for an loss, actions, claims, proceedings, demand or costs or damages whatsoever or howsoever caused arising directly or indirectly in connection with or arising out of the use of this material.

The emergence of new world-systems perspectives on global environmental change¹

Andrew K. Jorgenson and Jennifer E. Givens

The world is ‘full’ and ‘unequal’ (Milanovic 2005). This is scarcely a novel assertion and yet the implications remain fundamentally underappreciated. With roughly seven billion people and counting, and the consumption of energy and other natural resources at historically unprecedented levels, human societies are pushing up against the limits of global ecological systems. That the world remains vastly unequal in the wake of such pressures foreshadows the challenges facing the development prospects of the poorer countries – and it is an indication of the links between power, disparate economic development and patterns of global environmental change. World-systems analysis and emergent perspectives derived from it provide useful analytical tools for better understanding such complex society–nature relationships in their various manifestations (e.g. Goldfrank et al. 1999; Hornborg et al. 2007; Jorgenson and Kick 2006; Podobnik 2006; Roberts and Grimes 2002).

Broadly speaking, world-systems analysis (e.g. Chase-Dunn 1998; Wallerstein 1974) argues that a country’s domestic social and environmental conditions must be understood within the context of the entire capitalist world economy, which is characterized by relational processes of unequal development that generate and reproduce a core–periphery hierarchy. The central concept here is that a country’s economic development, levels of domestic income inequality, resource use, environmental harms and overall human well-being are not entirely a function of its own internal processes. Rather, they are at least partly a function of that country’s location in a global economic hierarchy, an international division of labour comprised of three zones: a core, semi-periphery and periphery. The core of the world economy, which consists of what are commonly referred to as developed countries, is characterized by capital-intensive production and high-wage labour. Labour-intensive production and low-wage labour are located in the periphery. Semi-peripheral nations hold relatively intermediate positions in the stratified interstate system, possessing a combination of both core-like and periphery-like characteristics. For analytical and empirical reasons, peripheral and semi-peripheral nations are commonly combined into the category of less-developed countries or developing countries.

Early quantitative, comparative work on the environment from a world-systems perspective largely focused on how resource consumption and environmental degradation patterns tightly correlate with the stratified interstate system (e.g. Burns et al. 1994, 1997; Goldfrank et al. 1999;

Kick et al. 1996). That scholarship was foundational in that it provided clear, robust evidence of such society–nature patterns within the core–periphery hierarchy.² However, that work was limited by the lack of theoretical and empirical attention paid to how political–economic conditions, relations and processes within the contemporary world served as key mechanisms leading to the well-documented patterns of global environmental inequalities within the world-system.

In recent years, two strands of theory and cross-national quantitative research have emerged to help reconcile limitations of earlier world-systems scholarship on the environment and to advance our collective understanding of the human dimensions of global environmental change. These two emergent areas of macrosociological work, commonly referred to as the ‘ecologically unequal exchange’ and ‘foreign direct investment (FDI) dependence and the environment’ traditions, are the primary focus of this chapter. In the next section, we review the theory of ecologically unequal exchange and summarize related research that employs relational measures and model estimation techniques to test its fundamental propositions. Next, we review and summarize findings for the FDI dependence and the environment tradition. In a brief conclusion, key points are summarized, with an emphasis on the two emergent traditions.

Ecologically unequal exchange

Recognition of the substantive, structured ecological relations between countries is increasingly articulated through the theory of ecologically unequal exchange, a perspective that describes the unequal material exchange relations and consequent ecological interdependencies within the capitalist world economy, all of which are fundamentally tied to wide disparities in socio-economic development and power embedded within the world-system (e.g. Hornborg 1998a, 1998b, 2009; Jorgenson 2006a; Jorgenson and Clark 2009, 2011; Rice 2007a; Roberts and Parks 2007, 2009). ‘Unequal exchange’ can be broadly defined as the assertion of asymmetrical power relationships between more-developed and less-developed countries, wherein the former gain disproportionate advantages at the expense of the latter through patterns of trade as well as other structural relationships. The assertion of unequal exchange relations diverges from neoclassical economic thought by inquiring into the historical power relations shaping present comparative advantages rather than taking present comparative advantage as a given.

In turn, ‘ecologically unequal exchange’ refers to the environmentally damaging withdrawal of energy and other natural resource assets from and the externalization of environmentally damaging production and disposal activities within less-developed countries. It constitutes the obtainment of ‘natural capital’ (stocks of natural resources that yield important goods and services) and the usurpation of ‘sink-capacity’ (waste assimilation properties of ecological systems in a manner enlarging the domestic carrying capacity of more powerful developed countries) to the detriment of developing countries. It is, therefore, focused upon the manner and degree to which less-developed countries tend to fulfil a role in the world-system as a tap for the raw materials and a sink for the waste products of industrialized (and post-industrial) countries, thereby underwriting the disproportionate production–consumption–accumulation processes of more-developed countries.

The unequal geographical distribution of energy and other natural resources suggests that trade among nations is a necessity and can contribute to more efficient and productive utilization from a global perspective. And yet in the modern world economy many export-oriented, less-developed countries remain mired in poverty, having failed to exhibit the vertical and horizontal economic diversification and growth that should follow temporally from specialization in their comparative advantages (Mahutga 2006). A conundrum, moreover, underlies the juxtaposition between those countries exhibiting the greatest consumption of natural resources

and those characterized by the greatest degradation or loss of natural resource assets: nations with the highest levels of natural resource consumption, principally the most industrialized and post-industrial countries, are typically characterized by the lowest domestic levels of environmental degradation (e.g. deforestation). In turn, the most intense natural resource degradation processes frequently beset the poorest countries in the world, those exhibiting minimal natural resource consumption demand. This inconsistency is referred to as the 'consumption/environmental degradation paradox' (e.g. Jorgenson 2003).

Bunker (1984, 1985) and Bunker and Ciccantell (2005) have crafted a body of comparative-historical work that is particularly responsive to the ecologically unequal connections forged through world-system processes. They illustrate the crucial role that reliable access to cheap natural resources has played in fuelling the rise of hegemonic powers within a given historical era. From their perspective, orthodox theories of development have insufficiently recognized the fundamental differences between the internal dynamics and logic of accumulation of extractive and productive economies, respectively. It is not extraction of natural resources and energy per se that promotes ecologically unequal exchange but the socio-organizational consequences this tends to produce between and within exporting and importing nations. The historical interactions between modes of extraction and production create path-dependent dynamics shaping the historical development trajectories of differentially situated countries.

Ecologically unequal exchange, therefore, is contingent upon differential cross-national social organization and accelerated production–consumption–accumulation linkages in the industrialized countries – facilitating the ability of state and private capital interests to determine global demand for natural resources (Bunker 1985; Hornborg 2011). Their capacity to control demand ensures that core interests engage in the substantive decisions regarding global export activity, and subjects less-developed countries to ever-changing market demands (Bunker 1985; Bunker and Ciccantell 2005). Local populations, social organization, infrastructure and ecosystems within peripheral extractive regions are often disrupted in the face of the malleable needs of core countries. Extractive regions failing to conform to core interests are likely to be subject to declining terms of trade or abandoned entirely in lieu of other, more accommodating locations. Differential cross-national social power, in turn, is based upon historically contingent exchange relationships forged through the ability to control asymmetrical flows of environmental resources and risks (Hornborg 2001).

These forms of transnational and international processes are also part and parcel of what McMichael (2008) refers to as the 'globalization project'. Pointing to a shift that began in the late 1970s and early 1980s, his analysis focuses on export-oriented production and the attraction of foreign direct investment as two related means that less-developed nations attempt to employ to stimulate economic development. Through formal and informal mechanisms, global institutions such as the World Bank and International Monetary Fund increasingly encourage such activities, which they promote as critically important for less-developed countries to establish positions in the increasingly integrated world economy (e.g. Babb 2005, 2009). In turn, the wealthier nations, by increasing consumption of manufactured products, agricultural goods and extracted materials, exacerbate environmental harms within developing countries. These constitute some of the key mechanisms underlying the ecologically unequal exchanges between developed and less-developed countries (e.g. Hornborg 1998a; Jorgenson 2006a; Rice 2007b).

The use of quantitative comparative methods to assess key assertions of ecologically unequal exchange theory is quite challenging.³ As implied by the theory, the vertical flow of exports from lesser-developed nations to relatively more-developed nations is a structural mechanism through which ecologically unequal consequences are born and maintained. On the flipside, it also matters where human-caused waste is generated, and where it is ultimately sent for disposal.

Over the past few years, a number of sociologists have attempted to develop and employ appropriate measures in comparative international studies to test propositions derived from ecologically unequal exchange theory. Early on, Jorgenson (2004) designed a measure – referred to as ‘weighted export flows’ – that quantifies the relative extent to which a nation’s exports are sent to more-developed countries. This weighted index, which involves the use of relational data (export flows between sending and receiving nations) and attributional data (levels of development of receiving nations), includes all primary sector and secondary sector exports. These data were used initially in a study of deforestation from 1990 to 2000, which concluded that the vertical flow of all exports contributes to forest degradation in less-developed countries, net of demographic and political-economic factors, including levels of exports and classic trade dependence measures (Jorgenson 2006a). In a related study, Jorgenson and Rice (2005) employ the same weighted index in a cross-sectional analysis of the per capita ecological footprints of less-developed countries. Results indicate that the vertical flow of exports suppresses consumption-based environmental demand within less-developed countries, many of which consume natural resources well below globally sustainable thresholds. Shandra et al. (2009b) use Jorgenson’s (2006a) weighted export flows measure as one of multiple predictors in an analysis of industrial organic water pollution in developing nations. Net of other political-economic and human-ecological factors, they find that less-developed countries with relatively greater levels of exports sent to more economically developed nations exhibit higher per capita levels of industrial organic water pollutants emitted per day in the year 2000.

Rice (2007b) conducts a cross-sectional analysis of the per capita ecological footprints of nations for a sample of both developed and less-developed countries. To test key tenants of ecologically unequal exchange theory, Rice employs a measure that identifies the percentage of a given country’s exports that are sent to core nations. While such a variable differs from the weighted export flows measures used by others, the general logic of the variable and its suitability for testing hypotheses is consistent with the former, and the two measures tend to be highly correlated (see Jorgenson 2012). Most notably, Rice (2007b) creates interactions between his trade measure and dummy variables for nations in differing income quartiles based on the World Bank’s country income classifications (i.e. low, lower-middle, upper-middle and high income). Results of cross-sectional models that include the interactions suggest that low and lower-middle income countries characterized by a greater proportion of exports to the core countries exhibit lower per capita footprints relative to nations that are upper-middle and high income. These results are consistent with propositions of ecologically unequal exchange theory and with world-systems logic in general, and highlight non-trivial differences in such structural relationships for nations at varying levels of development.

Combined, the above studies suggest that the resource consumption/environmental degradation paradox is, to some extent, two sides of the same coin in the context of ecologically unequal relationships between more-developed and less-developed countries. However, these studies are limited in particular ways. Jorgenson’s (2006a) deforestation analysis lacks temporal depth, and the use of a measure for all exports is problematic since research on forest degradation often emphasizes the relevance of trade in primary sector goods (e.g. Rudel 2005). Jorgenson and Rice (2005) conduct a cross-sectional analysis, which is indeed limited, yet the use of the weighted export flows measure for all commodity types is less problematic in this study since the dependent variable is the comprehensive per capita ecological footprint. The same cross-sectional limitations apply to Rice (2007b).

In part to address weaknesses in prior empirical work, Jorgenson et al. (2010a) employ a weighted flows measure for only primary sector goods in analyses of deforestation in less-developed countries from 1990 to 2005. Findings reveal a strong association between forest

degradation and the vertical flow of primary sector exports (see also Austin 2010 and Jorgenson 2010). Likewise, Shandra et al. (2009a) employ a weighted exports flow measure for primary sector commodities in an analysis of threatened mammals in less-developed countries in 2005. Their export measure is similar to that used in Rice (2007a) in that it quantifies the percentage of a sending nation's primary sector exports that goes to OECD countries, most of which are core nations. Consistent with the theory of ecologically unequal exchange, the results of their negative binomial regression model estimates indicate that numbers of threatened mammals in poor nations are positively associated with flows of primary sector exports to rich nations.

To help resolve the temporal limitations of prior cross-sectional studies, Jorgenson (2009b) employs more rigorous methods in panel analyses of the vertical flow of exports and the per capita ecological footprints of less-developed countries from 1975 to 2000. Results confirmed a negative association between the overall consumption-based environmental demands per person in developing countries and the flow of total exports from those countries to relatively more-developed nations. The association increased in magnitude over the entire twenty-five-year period, suggesting that these relationships became more ecologically unequal through time. Jorgenson et al. (2009) employ a similar approach, employing a weighted export flows measure for only primary sector commodities in panel analyses of deforestation and a refined, primary sector-oriented ecological footprint – known as the cropland, grazing land and timber footprint (CGT footprint) – for a sample of less-developed countries from 1970 to 2000. Like the preceding studies, their export flows measure is weighted by the levels of economic development of receiving countries. Jorgenson et al. (2009) estimate fixed and random effects models for both outcomes, allowing for more rigorous hypothesis testing. Consistent with prior research, they found that increases in the vertical flow of primary sector exports contributes to increases in forest degradation and concomitant suppression of the CGT footprint. The results hold, net of various controls and across both types of panel model estimations.

In perhaps one of the most thorough cross-national analyses in the ecologically unequal exchange tradition to date, Jorgenson and Clark (2009) integrate the tradition with two contemporary theories in environmental sociology: the treadmills of production and destruction, respectively. Treadmill of production theory focuses on how an economic system driven by endless growth, on an ever larger scale, generates widespread ecological degradation (Gould et al. 2008). Treadmill of destruction theory suggests that the military has its own expansionary dynamics, which involve significant environmental and ecological costs (Hooks and Smith 2005; Jorgenson et al. 2010a). Jorgenson and Clark (2009) argue that the ecologically unequal exchange perspective intersects with both treadmill orientations. The treadmill of production propels the world economy toward constant expansion, demanding more and more resources to meet its insatiable appetite, especially in the articulated consumer markets of developed countries. Similarly, in the interests of national security, technological innovation, political power and geopolitical influence, the treadmill of destruction facilitates the increased consumption of resources by the nations' militaries and their supporting sectors. As suggested by world-systems scholars, increased military strength enhances access to the natural resources and sink capacity of less-powerful, underdeveloped nations (e.g. Chase-Dunn 1998).

Jorgenson and Clark (2009) argue that the populations of more-developed *and* militarily powerful countries are positioned advantageously in the contemporary world economy, and thus more likely to secure and maintain favourable terms of trade allowing for greater access to the natural resources and sink capacity of bioproductive areas within less-developed countries. These advantageous positions facilitate the externalization of environmental costs of resource extraction and consumption to less-developed countries and help create conditions where more-developed countries and those with more powerful militaries are able to overutilize global

environmental space. The misappropriation of global environmental space suppresses resource consumption opportunities for the populations of many less-developed countries. Given the structure and acceleration of both the treadmill of destruction and treadmill of production, it is quite likely that the consequences of these processes for less-developed countries are more pronounced than for more-developed countries, and that they increase through time.

To test their arguments and assess the extent to which these perspectives intersect in meaningful and empirically valid ways, Jorgenson and Clark (2009) create and employ two export flows measures. One is weighted by the levels of economic development of receiving countries, the other by military expenditures per soldier of receiving countries. The two export flows measures are treated as predictors in panel analyses of the ecological footprints of nations from 1975 to 2000. Most notably, the results of their panel model estimates indicate that countries with relatively higher levels of exports sent to economically developed and militarily powerful nations experience suppressed consumption levels, and these effects – that are independent of one another – are especially pronounced and increasingly so for the less-developed countries, many of which consume resources well below globally sustainable thresholds. In other words, both forms of structural relationships between nations have become increasingly unequal in ecological contexts.

All of the scholarship discussed so far in this chapter focuses on how the structure of international trade in ecologically unequal contexts contributes to increased likelihood of environmental degradation in less-developed countries as well as the suppression of resource consumption for domestic populations in developing nations, often well below globally sustainable limits. The latter also contributes to the well-being of these populations, which underscores the complexity of resource use and human health associations (e.g. Rice 2008). At the same time, it is argued that ecologically unequal exchange relationships between nations are likely to contribute to an increase in the production and dumping of various forms of environmental waste in less-developed countries. Such waste is the result of the ‘off-shoring’ of environmentally intensive manufacturing and the externalizing of the post-consumption disposal costs associated with manufactured goods for the articulated markets in more-developed core countries. The focus here is on the international treatment of less-developed countries as ‘sinks’ for waste. While such unequal structural relationships and consequences are central to the theory of ecologically unequal exchange, comparative international research on these topics is limited. Three notable exceptions in sociology are Roberts and Parks (2007), Stretesky and Lynch (2009) and Jorgenson (2012), all of which focus on how ecologically unequal relationships contribute to anthropogenic carbon dioxide emissions. Given the scientific consensus on the role such emissions play in global climate change, these studies are far more than academic exercises.

Roberts and Parks (2007) estimate cross-sectional models of total emissions, per capita emissions, emissions per unit of production and cumulative emissions per capita for a large sample of nations. The first three outcomes are measured in 1999, while the fourth measure is a cumulative score for the 1950 to 1999 period. Net of multiple controls, they find that nations with a greater reliance on the export of manufactured goods have higher levels of all four types of emissions. Even though Roberts and Parks (2007) do not include relational measures of trade, their results are generally consistent with the arguments of ecologically unequal exchange theory. Stretesky and Lynch (2009) take a different approach that includes relational measures. Their cross-national panel analyses for the 1984 to 2004 period assess the extent to which a reliance on exports to the United States relative to other nations contributes to growth in carbon dioxide emissions. Results indicate that relatively higher levels of reliance on exports to the United States do contribute to growth in per capita carbon emissions. This study highlights the importance of focusing on specific trade relationships and their potential ecologically

unequal consequences. Though Stretesky and Lynch do not situate their research in an unequal exchange theoretical framework, they nonetheless make notable methodological and substantive contributions to that literature. Jorgenson (2012) conducts a longitudinal analysis of per capita carbon dioxide emissions for a large sample of developed and less-developed nations for the 1960 to 2005 period. Due to data availability challenges, he employs the same trade measure as Rice (2007b) to evaluate the propositions of ecologically unequal exchange theory. He finds that the effect of a country's proportion of exports to developed nations on per capita emissions is positive and much larger in magnitude for less-developed countries than for developed countries. Furthermore, and of particular note, in models for a sample restricted to less-developed countries, Jorgenson finds the magnitude of the effect of the vertical flow of exports on per capita emissions increases through time, providing evidence of increasingly ecologically unequal relationships between developed and less-developed countries. In the context of greenhouse gas emissions (Jorgenson 2012) and resource consumption levels (Jorgenson and Clark 2009), relationships between more-developed and less-developed nations appear to have become increasingly ecologically unequal.

The theory of ecologically unequal exchange has arguably become central in certain areas of academic discourse about society–nature relationships in international contexts, and the perspective has deep analytical roots in world-systems analysis. Comparative–historical work illustrates the long-term systemic processes that create and maintain conditions permitting such exchanges to occur between nations. Through quantitative studies, scholars using this approach have developed and employed measurements to test certain propositions of the theory, particularly those concerned with the environmental consequences of the upward, vertical flow of exports from less-powerful, less-developed nations to the more powerful and developed nations of the Global North. Further studies will refine such approaches and apply them to additional questions. Of particular need is for scholars to design measures that allow for testing propositions in comparative international analyses of the other side of the ecologically unequal exchange coin: the extent to which the flow of hazardous materials and other forms of waste from the Global North to the Global South impacts the environment and well-being of human populations in the latter (see Pellow 2007). In line with Jorgenson and Clark (2009), future research on ecologically unequal exchange relationships also needs to consider forms of power other than economic and, like Rice (2008) suggests, scholars working in this tradition would do well to pay closer attention to the human well-being consequences of such international and global dynamics.

This chapter turns now to a discussion of foreign investment dependence and the environment, a second emerging area of socio–environmental scholarship with deep roots in the world-systems tradition.

Foreign investment dependence and the environment

During recent decades, many less-developed countries experienced a deepening of foreign debt, resulting in austerity measures developed by global governance and finance institutions, in turn characteristics of the aforementioned 'globalization project' (McMichael 2008). These austerity measures, such as structural adjustment programmes, encourage the governments of indebted countries to create more favourable conditions for foreign investors and transnational corporations. At the heart of the austerity measures is the assumption that attracting foreign capital will stimulate economic development, thus assisting in debt repayment and increasing the overall well-being of domestic populations. It is often suggested (e.g. OECD 1999) that the longer-term benefits of foreign investment will outweigh any short-term environmental harms and human

well-being costs, and that attracting foreign investment might eventually lead to more environmentally-friendly forms of extraction and production in different sectors through technology transfers and spillover effects. It is anticipated, further, that investing transnational firms may be more likely to install and employ environmentally friendly technologies than their counterparts in host countries. Often referred to as the 'pollution halo hypothesis', this proposition is commonplace in economics (e.g. Birdsall and Wheeler 1993; Cole et al. 2008). Empirical support for the pollution halo hypothesis is lacking, however, especially in macro-comparative contexts (see Hoffman et al. 2005; Letchumanan and Kodama 2000; Perkins and Neumayer 2009).

Partly in an effort to attract foreign investment and transnational enterprises, many less-developed countries implement relaxed labour laws and tax reductions as well as exemptions to environmental regulations designed to protect the natural environment from activities in different sectors of the economy (Leonard 1988; McMichael 2008).⁴ The real or perceived threat of capital flight could be viewed as an additional incentive for less-developed countries to offer regulatory concessions to foreign capital. Further, prior research shows that some less-developed countries are less likely than many developed countries to ratify international environmental treaties, many of which deal explicitly with extractive and productive activities that are of direct relevance for transnational corporations (Roberts and Parks 2007). At least partly resulting from these unfolding political-economic processes, in general, the relative presence of foreign investment stocks for all economic sectors combined within less-developed countries increased substantially during recent decades (Chase-Dunn and Jorgenson 2007), and prior research shows that international debt and the implementation of structural adjustment programmes in less-developed countries do contribute to increases in inward foreign direct investment (Shandra et al. 2003).

With the above conditions in mind, and contrary to the pollution halo hypothesis, some world-systems influenced scholars have argued that a large proportion of secondary sector foreign direct investment in less-developed countries finances highly polluting and environmentally unfriendly manufacturing processes and facilities, much of which are outsourced from developed countries (e.g. Grimes and Kentor 2003; Jorgenson 2007; Jorgenson et al. 2007). Transnational manufacturing firms often experience economic benefits from this form of environmental cost-shifting since ecologically harmful manufacturing methods tend to include relatively outdated and inexpensive mechanization processes and equipment. This also allows transnational firms to further distance themselves in the public eye from the environmental impacts of their activities.⁵ Moreover, the transportation vehicles owned and operated by foreign-owned manufacturing centres in less-developed countries for the movement of inputs, outputs and labour are often outdated, energy-inefficient and thus more polluting (Jorgenson et al. 2007). What is more, the 'on-the-ground' transportation infrastructure of many less-developed countries tends to be poorly maintained relative to developed countries. For example, roadways are less likely to be paved on a regular basis, and rail systems are more likely to be spotty in different areas. Such conditions can lead to the increased use of fossil fuels by transnational firms for the transportation of raw materials, manufactured goods, and labour (Grimes and Kentor 2003). In line with these arguments, comparative international research indicates that within less-developed countries, manufacturing sector FDI positively affects growth in carbon dioxide emissions (e.g. Grimes and Kentor 2003; Jorgenson 2009a; York 2008) as well as other greenhouse gases (Dick and Jorgenson 2010; Jorgenson 2006b) and industrial organic water pollution (Jorgenson 2009b). These results hold regardless if the emissions or pollution outcome are measured by scale, intensity or per unit of production.

In a related vein, scholars in this tradition have empirically demonstrated that foreign investment in the primary sector (i.e. agriculture, forestry, mining) commonly finances agricultural

activities, forestry operations and extractive enterprises that contribute to the degradation of forested areas in less-developed countries (e.g. Jorgenson 2008; Jorgenson et al. 2011). As agricultural enterprises are integrated into the world economy, especially those owned by transnational firms, the scale and intensity of their production tends to increase dramatically (Harper and Le Beau 2003). To augment production, forest areas are cleared in a variety of ways, including the burning of biomass and the use of tractors as well as other types of machinery (Altieri 2000). Forest areas are also cleared for export-oriented livestock operations, many of which are controlled by foreign capital (Burns et al. 1994; Jorgenson and Birkholz 2010). Forms of capital-intensive agriculture can deplete the soil of nutrients, which leads to further expansion and concomitant deforestation (Magdoff et al. 2000).

Many less-developed countries, especially those with relatively larger forest areas, are prime locations for logging operations, and indebted countries are often encouraged to utilize their natural resources, including forested areas, as a form of comparative advantage to attract foreign capital (McMichael 2008). Thus, like agriculture, forestry in general and logging operations in particular have gradually become transnationally organized and globally distributed. The extraction of minerals and other raw materials are the starting points for most global production systems, and transnational firms are key actors in these primary sector activities (Bunker and Ciccantell 2005). Mining activities are carried out in a series of stages, each of which are potentially detrimental to forested areas (Rudel 2005).

Comparative international research in this arena also links primary sector FDI in less-developed countries to growth in the use of synthetic pesticides and fertilizers in agricultural production (e.g. Jorgenson and Kuykendall 2008; see also Frey 1995). In the contemporary world economy, much of the production of agricultural goods is globally distributed and largely controlled by transnational corporations headquartered in developed countries (McMichael 2008). Harriett Friedmann (1990) refers to the rising oligopolistic control of global food production as the 'world food order'. As farming systems in less-developed countries are integrated into the world economy, often through the influence and control of transnational corporations and foreign capital, crop rotation and recycling of organic matter is more likely to be replaced by the high-intensity use of pesticides and synthetic fertilizers (Altieri 2000).⁶ Transnational corporations investing in or directly operating capital-intensive agriculture within less-developed countries are principal customers for pesticides and fertilizers, some of which are banned in developed countries, but provide potential markets for their producers in locales with fewer environmental protection barriers (Magdoff et al. 2000). What is more, in a treadmill-like fashion, the use of such agrochemicals often increases through time as more are needed to maintain or increase crop yields, and longitudinal research shows a strong correlation in less-developed countries between increases in primary sector FDI and heightened use of both pesticides and synthetic fertilizers (Jorgenson and Kuykendall 2008).

Overall, research results generally supports the world-systems-influenced propositions that increased FDI in primary and secondary sectors contributes to a concomitant increase in environmental problems in less-developed, investment-dependent nations. Considering the globalization and outsourcing of service industries, future research needs to examine the potential environmental impacts of tertiary sector FDI (e.g. tourism, telecommunications and financial and legal services) in less-developed countries as well. Further, emerging studies in the world society tradition within sociology and its sister disciplines suggest that various civil society and institutional factors, such as environmental international non-governmental organizations and national environmental ministries, are capable of mitigating – to some extent – the environmental impacts of foreign direct investment in less-developed countries (e.g. Jorgenson 2009c; Jorgenson et al. 2011; see also Schofer and Hironaka 2005). Future research on the environmental impacts of

any form of FDI would do well to consider such institutional and civil society factors and their mitigating capabilities.

Conclusion

This chapter has highlighted two emergent lines of comparative analysis on society–nature relationships, both of which are influenced by foundational world-systems and environment works of earlier decades. First, ecologically unequal exchange theory and related research considers how particular aspects of international trade – especially the vertical flow of exports – allow more powerful developed nations to externalize at least some of their environmental impacts to less-developed nations, leading to increases in various forms of environmental harms in the latter, including deforestation, loss of biodiversity, industrial water pollution and greenhouse gas emissions. Resource consumption levels of the less-developed countries often remain suppressed well below globally sustainable thresholds, with significant public health implications. Evidence indicates increasingly unequal relationships through time. Second, scholarship on foreign investment dependence and the environment empirically demonstrates that increased levels of foreign investment within less-developed countries, rather than leading to the spread of cleaner technologies and production processes in the secondary and primary sectors, often are linked to dirtier forms of extraction and production, various forms of environmental harms and subsequent costs to human well-being. Theoretical explanations for these relationships are complex, involving various historical and relational processes within the world-system.

While these two emergent areas of scholarship increase our understanding of human dimensions of global environmental change and address limitations of past studies on the relationships between the contemporary capitalist world-system and the environment, like all areas of social scientific inquiry, they have limitations as well. Most notably, work in the ecologically unequal exchange tradition has yet to adequately examine how the structure of international exchanges allows wealthier and more powerful nations to export hazardous waste to less-developed and less-powerful nations. Though much needed, in-depth case studies in this tradition are few and far between. The latter limitation applies as well to scholarship on foreign investment dependence and the environment. In addition, that area of study has yet to focus on possible environmental impacts of foreign direct investments in the services sector, an increasingly important area of investment in many less-developed countries. The two emerging traditions of scholarship on world-systems and the environment will be further enriched as they address these limitations in coming years.

Notes

- 1 Portions of this chapter also appear in Jorgenson and Rice (2012) and Jorgenson and Winitzky (2012).
- 2 A decade ago, Roberts and Grimes (2002) provided a thorough discussion of the need to study environmental and ecological disruptions from a world-systems perspective. Their essay reviews the foundational bodies of research that identified strong correlations between various environmental harms and world-system position.
- 3 Recent historical analyses (e.g. Clark and Foster 2009) and in-depth case studies (e.g. Hornborg 2006) focus on the underlying mechanisms that collectively shape and reinforce the broader structural relationships identified by the quantitative inquiries.
- 4 However, such exemptions are less common now than in past decades.
- 5 However, partly due to the pressures of social justice and environmental justice groups, major corporations such as Apple and Nike are increasingly being held accountable for the behaviours and practices of their facilities, contractors and subcontractors.

- 6 Of additional importance, the use of pesticides and fertilizers in agricultural production is linked to a variety of human health and environmental problems. See Jorgenson and Kuykendall (2008) for an extended discussion of the known public health and environmental problems associated with their use.

References

- Altieri, M. (2000) 'Ecological Impacts of Industrial Agriculture and the Possibilities for Truly Sustainable Farming', pp.77–92 in F. Magdoff, J. Foster and F. Buttel (eds), *Hungry for Profit: The Agribusiness Threat to Farmers, Food, and the Environment*. New York, NY: Monthly Review Press.
- Austin, K. (2010) 'The Hamburger Connection as Ecologically Unequal Exchange: A Cross-National Investigation of Beef Exports and Deforestation in Less-Developed Countries', *Rural Sociology*, 75, 2, pp. 270–299.
- Babb, S. (2005) 'The Social Consequences of Structural Adjustment: Recent Evidence and Current Debates', *Annual Review of Sociology*, 31, pp. 199–222.
- Babb, S. (2009) *Behind the Development Banks: Washington Politics, World Poverty, and the Wealth of Nations*. Chicago, IL: University of Chicago Press.
- Birdsall, N. and Wheeler, D. (1993) 'Trade Policy and Industrial Pollution in Latin America: Where are the Pollution Havens?' *Journal of Environment and Development*, 2, 1, pp. 137–147.
- Bunker, S.G. (1984) 'Modes of Extraction, Unequal Exchange, and the Progressive Underdevelopment of an Extreme Periphery: The Brazilian Amazon, 1600–1980', *American Journal of Sociology*, 89, 5, pp. 1017–1064.
- Bunker, S.G. (1985) *Underdeveloping the Amazon: Extraction, Unequal Exchange, and the Failure of the Modern State*. Urbana, IL: University of Illinois Press.
- Bunker, S.G. and Ciccantell, P.S. (2005) *Globalization and the Race for Resources*. Baltimore, MD: Johns Hopkins University Press.
- Burns, T., Davis, B. and Kick, E. (1997) 'Position in the World-System and National Emissions of Greenhouse Gases', *Journal of World-Systems Research*, 3, 3, pp. 432–466.
- Burns, T., Kick, E., Murray, D. and Murray, D. (1994) 'Demography, Development, and Deforestation in a World-System Perspective', *International Journal of Comparative Sociology*, 35, 3–4, pp. 221–239.
- Chase-Dunn, C. (1998) *Global Formation: Structures of the World-Economy*. Lanham, MD: Rowman and Littlefield.
- Chase-Dunn, C. and Jorgenson, A. (2007) 'Trajectories of Trade and Investment Globalization', pp. 165–184 in I. Rossi (ed.), *Frontiers of Globalization Research*. New York, NY: Springer.
- Clark, B. and Foster, J.B. (2009) 'Ecological Imperialism and the Global Metabolic Rift: Unequal Exchange and the Guano/Nitrates Trade', *International Journal of Comparative Sociology*, 50, 3–4, pp. 311–334.
- Cole, M., Elliott, R. and Strobl, E. (2008) 'The Environmental Performance of Firms: The Role of Foreign Ownership, Training, and Experience', *Ecological Economics*, 65, 3, pp. 538–546.
- Dick, C. and Jorgenson, A. (2010) 'Sectoral Foreign Investment and Nitrous Oxide Emissions: A Quantitative Investigation', *Society and Natural Resources*, 23, 1, pp. 71–82.
- Frey, R.S. (1995) 'The International Traffic in Pesticides', *Technological Forecasting and Social Change*, 50, 2, pp. 151–169.
- Friedmann, H. (1990) 'The Origins of Third World Food Dependence', pp. 13–31 in B. Bernstein, B. Crow, M. McIntosh and C. Martin (eds), *The Food Question: Profits vs People*. New York, NY: Monthly Review Press.
- Goldfrank, W., Goodman, D. and Szasz, A. (eds) (1999) *Ecology and the World-System*. Westport, CT: Greenwood Press.
- Gould, K., Pellow, D. and Schnaiberg, A. (2008) *The Treadmill of Production: Injustice and Unsustainability in the Global Economy*. Boulder, CO: Paradigm Publishers.
- Grimes, P. and Kentor, J. (2003) 'Exporting the Greenhouse: Foreign Capital Penetration and CO₂ Emissions 1980–1996', *Journal of World-Systems Research*, 9, 2, pp. 261–275.
- Harper, C. and LeBeau, B. (2003) *Food, Society, and Environment*. Upper Saddle River, NJ: Prentice Hall.
- Hoffman, R., Chew Sing, L., Ramasamy, B. and Yeung, M. (2005) 'FDI and Pollution: A Granger Causality Test Using Panel Data', *Journal of International Development*, 17, 3, pp. 311–317.
- Hooks, G. and Smith, C. (2005) 'Treadmills of Production and Destruction: Threats to the Environment Posed by Militarism', *Organization and Environment*, 18, 1, pp. 19–37.
- Hornborg, A. (1998a) 'Ecosystems and World Systems: Accumulation as an Ecological Process', *Journal of World-Systems Research*, 4, 2, pp. 169–177.

- Hornborg, A. (1998b) 'Towards an Ecological Theory of Unequal Exchange: Articulating World System Theory and Ecological Economics', *Ecological Economics*, 25, 1, pp. 127–136.
- Hornborg, A. (2001) *The Power of the Machine: Global Inequalities of Economy, Technology, and Environment*. New York, NY: AltaMira Press.
- Hornborg, A. (2006) 'Footprints in the Cotton Fields: The Industrial Revolution as Time-Space Appropriation and Environmental Load Displacement', *Ecological Economics*, 59, 1, pp. 74–81.
- Hornborg, A. (2009) 'Zero-Sum World: Challenges in Conceptualizing Environmental Load Displacement and Ecologically Unequal Exchange in the World-System', *International Journal of Comparative Sociology*, 50, 3–4, pp. 237–262.
- Hornborg, A. (2011) *Global Ecology and Unequal Exchange: Fetishism in a Zero-Sum World*. New York, NY: Routledge.
- Hornborg, A., McNeill, J.R. and Martinez-Alier, J. (eds)(2007) *Rethinking Environmental History: World-System History and Global Environmental Change*. Lanham, MD: Alta Mira Press.
- Jorgenson, A.K. (2003) 'Consumption and Environmental Degradation: A Cross-National Analysis of the Ecological Footprint', *Social Problems*, 50, 3, pp. 374–394.
- Jorgenson, A.K. (2004) 'Export Partner Dependence and Environmental Degradation, 1965–2000'. Ph.D. dissertation, Department of Sociology, University of California, Riverside.
- Jorgenson, A.K. (2006a) 'Unequal Ecological Exchange and Environmental Degradation: A Theoretical Proposition and Cross-National Study of Deforestation, 1990–2000', *Rural Sociology*, 71, 4, pp. 685–712.
- Jorgenson, A.K. (2006b) 'Global Warming and the Neglected Greenhouse Gas: A Cross-National Study of Methane Emissions Intensity, 1995', *Social Forces*, 84, 3, pp. 1777–1796.
- Jorgenson, A.K. (2007) 'Does Foreign Investment Harm the Air We Breathe and the Water We Drink? A Cross-National Study of Carbon Dioxide Emissions and Organic Water Pollution in Less-Developed Countries, 1975–2000', *Organization and Environment*, 20, 2, pp. 137–156.
- Jorgenson, A.K. (2008) 'Structural Integration and the Trees', *Sociological Quarterly*, 49, 3, pp. 503–527.
- Jorgenson, A.K. (2009a) 'The Transnational Organization of Production, the Scale of Degradation and Ecoefficiency: A Study of Carbon Dioxide Emissions in Less-Developed Countries', *Human Ecology Review*, 16, 1, pp. 64–74.
- Jorgenson, A.K. (2009b) 'The Sociology of Unequal Exchange in Ecological Context: A Panel Study of Lower-Income Countries, 1975–2000', *Sociological Forum*, 24, 1, pp. 22–46.
- Jorgenson, A.K. (2009c) 'Foreign Direct Investment and the Environment, the Mitigating Influence of Institutional and Civil Society Factors, and Relationships between Industrial Pollution and Human Health: A Panel Study of Less-Developed Countries', *Organization and Environment*, 22, 2, pp. 135–157.
- Jorgenson, A.K. (2010) 'World-Economic Integration, Supply Depots, and Environmental Degradation: A Study of Ecologically Unequal Exchange, Foreign Investment Dependence, and Deforestation in Less-Developed Countries', *Critical Sociology*, 36, 3, pp. 453–477.
- Jorgenson, A.K. (2012) 'The Sociology of Ecologically Unequal Exchange and Carbon Dioxide Emissions, 1960–2005', *Social Science Research*, 41, pp. 242–252.
- Jorgenson, A.K., Austin, K. and Dick, C. (2009) 'Ecologically Unequal Exchange and the Resource Consumption/Environmental Degradation Paradox: A Panel Study of Less-Developed Countries, 1970–2000', *International Journal of Comparative Sociology*, 50, 3–4, pp. 263–284.
- Jorgenson, A.K. and Birkholz, R. (2010) 'Assessing the Causes of Anthropogenic Methane Emissions in Comparative Perspective, 1990–2005', *Ecological Economics*, 69, pp. 2634–2643.
- Jorgenson, A.K. and Clark, B. (2009) 'The Economy, Military, and Ecologically Unequal Relationships in Comparative Perspective: A Panel Study of the Ecological Footprints of Nations, 1975–2000', *Social Problems*, 56, 4, pp. 621–646.
- Jorgenson, A.K. and Clark, B. (2011) 'Societies Consuming Nature: A Panel Study of the Ecological Footprints of Nations, 1960–2003', *Social Science Research*, 40, 1, pp. 226–244.
- Jorgenson, A.K. and Clark, B. (2012) 'Are the Economy and the Environment Decoupling? A Comparative International Study, 1960–2005', *American Journal of Sociology*, 118, 1, pp. 1–44.
- Jorgenson, A.K., Clark, B. and Kentor, J. (2010a) 'Militarization and the Environment: A Panel Study of Carbon Dioxide Emissions and the Ecological Footprints of Nations, 1970–2000', *Global Environmental Politics*, 10, 1, pp. 7–29.
- Jorgenson, A.K., Dick, C. and Austin, K. (2010b) 'The Vertical Flow of Primary Sector Exports and Deforestation in Less-Developed Countries: A Test of Ecologically Unequal Exchange Theory', *Society and Natural Resources*, 23, 9, pp. 888–897.

- Jorgenson, A.K., Dick, C. and Mahutga, M. (2007) 'Foreign Investment Dependence and the Environment: An Ecostructural Approach', *Social Problems*, 54, 3, pp. 371–394.
- Jorgenson, A.K., Dick, C. and Shandra, J. (2011) 'World Economy, World Society, and Environmental Harms in Less-Developed Countries', *Sociological Inquiry*, 81, 1, pp. 53–87.
- Jorgenson, A.K. and Kick, E. (eds) (2006) *Globalization and the Environment*. Leiden: Brill.
- Jorgenson, A.K. and Kuykendall, K. (2008) 'Globalization, Foreign Investment Dependence, and Agriculture Production', *Social Forces*, 87, 1, pp. 529–560.
- Jorgenson, A.K. and Rice, J. (2005) 'Structural Dynamics of International Trade and Material Consumption: A Cross-National Study of the Ecological Footprint of Less-Developed Countries', *Journal of World-Systems Research*, 11, 1, pp. 57–77.
- Jorgenson, A. K. and Rice, J. (2012) 'The Sociology of Ecologically Unequal Exchange in Comparative Perspective', pp. 431–439 in S. Babones and C. Chase-Dunn (eds), *Routledge Handbook of World-Systems Analysis*. London: Routledge.
- Jorgenson, A. K. and Winitzky, J. (2012) 'The Environmental Impacts of Foreign Direct Investment in Less-Developed Countries', pp. 445–448 in S. Babones and C. Chase-Dunn (eds), *Handbook of World-Systems Analysis: Theory and Research*. London: Routledge.
- Kick, E., Burns, T., Davis, B., Murray, D. and Murray, D. (1996) 'Impacts of Domestic Population Dynamics and Foreign Wood Trade on Deforestation: A World-System Perspective', *Journal of Developing Societies*, 12, 1, pp. 68–87.
- Leonard, J. (1988) *Pollution and the Struggle for the World Product*. Cambridge, UK: Cambridge University Press.
- Letchumanan, R. and Kodama, F. (2000) 'Reconciling the Conflict Between the "Pollution Haven Hypothesis and an Emerging Trajectory of International Technology Transfer', *Research Policy*, 29, 1, pp. 59–79.
- McMichael, P. (2008) *Development and Social Change: A Global Perspective*. Thousand Oaks, CA: Pine Forge Press.
- Mahutga, M. (2006) 'The Persistence of Structural Inequality? A Network Analysis of International Trade, 1965–2000', *Social Forces*, 84, 4, pp. 1863–1889.
- Magdoff, J., Foster, J.B. and Buttel, F. (2000) *Hungry for Profit: The Agribusiness Threat to Farmers, Food, and the Environment*. New York, NY: Monthly Review Press.
- Milanovic, B. (2005) *Worlds Apart: Measuring International and Global Inequality*. Princeton: Princeton University Press.
- Organisation for Economic Co-operation and Development (OECD) (1999) *Foreign Direct Investment and the Environment*. Paris: OECD Publications.
- Pellow, D. (2007) *Resisting Global Toxins: Transnational Movements for Environmental Justice*. Cambridge, MA: MIT Press.
- Perkins, R. and Neumayer, E. (2009) 'Transnational Linkages and the Spillover of Environment-Efficiency into Developing Countries', *Global Environmental Change*, 19, 3, pp. 375–383.
- Podobnik, B. (2006) *Global Energy Shifts: Fostering Sustainability in a Turbulent Age*. Philadelphia, PA: Temple University Press.
- Rice, J. (2007a) 'Ecological Unequal Exchange: Consumption, Equity and Unsustainable Structural Relationships within the Global Economy', *International Journal of Comparative Sociology*, 48, 1, pp. 43–72.
- Rice, J. (2007b) 'Ecological Unequal Exchange: International Trade and Uneven Utilization of Environmental Space in the World System', *Social Forces*, 85, 3, pp. 1369–1392.
- Rice, J. (2008) 'Material Consumption and Social Well-Being within the Periphery of the World Economy: An Ecological Analysis of Maternal Mortality', *Social Science Research*, 37, 4, pp. 1292–1309.
- Roberts, J.T. and Grimes, P. (2002) 'World-System Theory and the Environment: Toward a New Synthesis', pp. 167–196 in R. Dunlap, F. Buttel, P. Dickens and A. Gijswijt (eds), *Sociological Theory and the Environment: Classical Foundations, Contemporary Insights*. Lanham, MD: Rowman and Littlefield.
- Roberts, J.T. and Parks, B. (2007) *A Climate of Injustice: Global Inequality, North–South Politics, and Climate Policy*. Cambridge, MA: MIT Press.
- Roberts, J.T. and Parks, B. (2009) 'Ecologically Unequal Exchange, Ecological Debt, and Climate Justice: The History and Implications of Three Related Ideas for a New Social Movement', *International Journal of Comparative Sociology*, 50, 3–4, pp. 385–409.
- Rudel, T. (2005) *Tropical Forests: Regional Paths of Destruction and Regeneration in the Late Twentieth Century*. New York, NY: Columbia University Press.
- Schofer, E. and Hironaka, A. (2005) 'The Effects of World Society on Environmental Outcomes', *Social Forces*, 84, 1, pp. 25–47.

- Shandra, J., Leckband, C., McKinney, L. and London, B. (2009a) 'Ecologically Unequal Exchange, World Polity, and Biodiversity Loss: A Cross-National Analysis of Threatened Mammals', *International Journal of Comparative Sociology*, 50, 3–4, pp. 285–310.
- Shandra, J., Ross, R. and London, B. (2003) 'Global Capitalism and the Flow of Foreign Direct Investment to Non-Core Nations, 1980–1996', *International Journal of Comparative Sociology*, 44, 3, pp. 199–238.
- Shandra, J., Shor, E. and London, B. (2009b) 'World Polity, Unequal Exchange, and Organic Water Pollution: A Cross-National Analysis of Less Developed Nations', *Human Ecology Review*, 16, 1, pp. 51–64.
- Stretesky, P. and Lynch, M. (2009) 'A Cross-National Study of the Association Between Per Capita Carbon Dioxide Emissions and Exports to the United States', *Social Science Research*, 38, 1, pp. 239–250.
- Wallerstein, I. (1974) *The Modern World System*, vol 1., *Capitalist Agriculture and the Origins of the European World-Economy in the Sixteenth Century*. New York: Academic Press.
- York, R. (2008) 'De-Carbonization in the Former Soviet Republics, 1992–2000: The Ecological Consequences of De-Modernization', *Social Problems*, 55, 3, pp. 370–390.