Theorizing Land-Cover and Land-Use Change: The Case of the Florida Everglades and Its Degradation

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This paper possesses two related objectives. The first is to unite the bid-rent model of von Thünen and urban theorists with historical analysis in the interest of providing a theoretical approach to the comprehension of regional land-cover and land-use change. The second objective is to deploy the theoretical approach in an attempt to account for a specific change process, namely loss of wetlands in South Florida. Recently, the *Annals of the Association of American Geographers* published a paper addressing this issue (Meindl, Alderman, and Waylen 2002). Meindl, Alderman, and Waylen describe the impact of claims making on efforts to drain and sell land in South Florida during a critical period in the early 20th century. The present paper is put forward, in part, to provide additional context. In particular, we identify claims making and the development discourse it legitimated as part of a complex evolution in the region's socionature, and the regimes governing land-cover and land-use change that led to wetlands reclamation. To explain these regime shifts, we criticize conventional bid-rent theory and develop a model integrating urban and agricultural land use whose structure is affected by development. We then deploy this model to the Everglades case, using historical narrative and remotely sensed land-cover data. We conclude the paper calling for integrated theoretical approaches in attempts to comprehend land-cover and land-use change and associated environmental problems. *Key Words: Land-cover and land-use change, Florida Everglades, von Thünen.*

"What have they done to the earth?"

—*When the Music's Over*, Jim Morrison and The Doors

It is widely claimed that nature and society do not exist as independent entities, but rather as parts of an interdependent whole, a hybrid socionature that includes social, ecological, and discursive components (Smith 1984; Harvey 1996; Peet and Watts 1996; Swyngedouw 1999; Castree and Braun 2001). Be this as it may, much research on the critical environmental issue of land-cover and land-use change (Turner et al. 1995; IGBP-IHDP 1999) has tended to advance one-way causality models addressing how a material process, namely replacement of one type of land cover by another, responds to collections of mostly physical and socio-economic variables (e.g., Kaimowitz and Angelsen 1998; Geist and Lambin 2002). Although our understanding of land-cover and land-use change has improved since early studies on deforestation by Myers (1980), Allen and Barnes (1985), and Rudel (1989), it does appear that theoretical elaboration is underdeveloped (European Space Agency 1994; Kaimowitz and Angelsen 1998; Geist and Lambin 2001; Lambin et al. 2001; Irwin and Geoghegan 2001; Geist and Lambin 2002). Economists and spatial theorists have provided behavioral theory in specifying "spatially explicit models," but the fact remains that both profit and utility maximization are exceedingly context dependent as conceptual principles and completely inattentive to social structure or discourse (e.g., Bockstael 1996; Nelson and Hellerstein 1997).

While it seems that land-cover and land-use change research still remains under-theorized, applications making use of structural elements that specifically attempt to examine and explain these issues are few and far between. It is an important goal of the present paper to provide one.[1] In particular, we address the regimes of land-cover change that have governed the construction of South Florida's socionature in an explicit effort to unite an explanation of material process with a political economy perspective that, in this case, includes a specification of the historical and current interconnections between the region's social structure, agents, and environmental discourse (Swyngedouw 1999). Such an undertaking arrives at a propitious moment, given ongoing environmental controversy in the region (Walker and Solecki 2001). A recent article in the *Annals of the Association of American Geographers* by Christopher Meindl, Derek Alderman, and Peter Waylen (2002) also addressed the issue. The narrative presented by Meindl, Alderman, and Waylen is an important one in that it directs attention to the role of discourse and, in particular, the ideologically powerful claims of scientists in prepping the material groundwork for environmental change, in this case the draining of the Everglades.[2] In general, the role of agents and the

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discourses they use in furthering their actions have received little empirical attention in the environmental change literature, despite proliferating interest in so-called agent-based models (Dawson et al. 2003).

The present article is put forward partly in response to the argument made by Meindl, Alderman, and Waylen (2002) regarding the stimulus to Everglade's drainage efforts provided by the optimistic report on the subject written by James O. Wright under U.S. Department of Agriculture auspices. We suggest that the claims made by Wright and the developmental ideology to which they contributed provide only one chapter in the history of South Florida's socionature and that the region's environmental crisis is the outcome of a long-run, many-stepped process, not the result of an engineering fiasco brought on by the claims-making activities of key individuals. Similarly, promotional claims about how increased rain would result from breaking the sod made by scientists in the Great Plains during the late 19th century were by no means the singular spark to that region's development (Webb 1931; Libecap and Hansen 2001).

Our account is not necessarily at odds with that of Meindl, Alderman, and Waylen (2002), although we do raise several discussion points in the conclusion. We view our endeavor to be one of expanding and complementing the important themes broached by Meindl and colleagues and of completing the South Florida story by linking environmental crisis to processes of regional land-cover change. To this end, we utilize historical data on land cover, economic activity, and policy shifts, together with a retheorization of interactions between urban and rural land uses, to illustrate the region's long-run landscape transformation. We argue that government land transfers, engineering, claims making, and the development discourse of state boosterism served the acquisitive impulses of capital and its early South Florida strategy of profiting from the creation of land for agricultural and residential purposes.

Through this lens, the actions taken and claims made by individuals promoting drainage are seen as part of a nuanced and complex process involving a variety of agents who were active in the South Florida landscape for over 100 years, including state bureaucrats and politicians, northern capitalists, local land developers, and federal agencies like the Army Corps of Engineers. Thus, our time frame contrasts with that of Meindl, Alderman, and Waylen (2002), who focus on the controversial period between about 1910 and 1930, when progressives in Florida state government built several drainage canals in South Florida, but failed to drain the Everglades sufficiently to meet the demands of local residents and land owners.

The environmental crisis of South Florida can be defined specifically as the outgrowth of wetlands reclamation undertaken to provide arable land for agriculture, and, more generally, human settlement. But this facile conclusion conceals a compelling question, namely, can the historic record be joined to an identification of the land-cover change regimes that have generated crisis? We suggest that a suitably adapted bid-rent formulation can accomplish such a task if given historical meaning and interpretation. In particular, the model elaborated by Walker (2001) integrating urban and agricultural spaces can be suitably adapted to illuminate in a specific regional setting the dynamics broadly noted by Cronon (1991), who used an historicized adaptation of von Thünen to describe the necessary linkages between the growth of Chicago and frontier expansion in the "Great West." In the present case, urban growth along the so-called Gold Coast of Southeast Florida was part and parcel of the rural process of wetlands reclamation and extension of the human use of land into the vastness of the Everglades. So was South Florida's socionature formed.

The substantive elements of the paper are organized as follows. First, the theory of bid-rent stemming from von Thünen is considered in light of recent criticisms by both social theorists and economists. Difficulties in applying the existing framework to land-cover and land-use change are pointed out, as are the adaptations that would be necessary to make it reflective of real-world conditions. As shall be seen, the main problem arises from a failure to attend to political economy and historical change (Cronon 1991). The theoretical discussion is followed by a description of the bid-rent model provided by Walker (2001), a presentation of long-run land-cover change data for South Florida, an historical account of the region's development, and an application of Walker's model to the development narrative. The paper concludes with a critical assessment of the argument made by Meindl, Alderman, and Waylen (2002) and with an appraisal of the epistemological utility of von Thünen to the nature-society discourse. Before beginning, however, we briefly describe the environmental changes that have generated controversy and, in so doing, paved the way to current attempts to restore ecological function to the Everglades (Walker and Solecki 2001; National Research Council 2003a and 2003b).

Environmental Changes in South Florida

The environmental crisis in South Florida has many dimensions, but much popular concern has focused on impacts affecting the megafauna, particularly wading bird populations. Land-cover change throughout the region has permanently altered the hydrologic regime and, as a consequence, considerably reduced nesting pairs of the great egret, the tricolored heron, the snowy egret, the white ibis, and the wood stork (Ogden 1994; Robertson and Frederick 1994). The southern Everglades may have maintained a population of 1 million wading birds into the 1930s. Ogden (1994) estimates the postdrainage maximum (for 1976) at 50,000. Although early estimates were possibly inflated to generate public support for the creation of Everglades National Park, the fact remains that these birds have suffered a drastic decline in numbers (Frohring, Voorhees, and Kushlan 1988).

The American alligator has also been affected by loss of habitat precipitated by land-cover change. It is impossible to provide estimates of their early abundance, although population fluctuations have been recorded (Mazzotti and Brandt 1994; Craighead 1968). Their numbers decreased due to overharvesting and drainage in the 1930s. A rebound followed with the creation of Everglades National Park, and the 1950s showed a period of population growth that ended dramatically, with a 90 percent decline brought on by water management, poaching, and drought (Craighead 1968). Designation of the species first as endangered, then as threatened, stabilized the population, but at a level lower than predevelopment numbers due to salinization of mangrove estuaries and loss of peripheral wet prairies, their historic habitats.

Other animal species affected by natural areas encroachment and habitat degradation include the Florida panther, down to between 30 and 50 individuals (Allmen 1996; Florida Game and Fresh Water Fish Commission 1992); the American crocodile, presently reduced to 500, about 20–50 percent of its predevelopment population (Cox et al. 1993), and the snail kite, whose numbers have declined nearly an order of magnitude, from the high hundreds and possibly thousands, to the low hundreds, with near extinction in the middle years of the 20th century (Bennetts, Collopy, and Rodgers, Jr. 1994).

Of course, environmental degradation in South Florida is not restricted to stress on the populations of large animals. Problems associated with saltwater intrusion, muck fires, exotic species invasions, and drought have chronically plagued area residents. Of particular concern at the present time is eutrophication, the problem that sparked the federal suit in 1988 against the State of Florida, thereby precipitating the restoration initiative. Predrainage conditions were at the limit of detection, about .01 mg/L. This has increased by over an order of magnitude, and waters flowing directly from agricultural areas south of Lake Okeechobee to the northern and central Everglades, and even into Everglades National Park, now carry concentrations of between .15 and .20 mg/L (Davis 1994). Cattail marshes have replaced extensive areas of sawgrass, partly as a consequence (John 1994).

In sum, both biotic and abiotic components of South Florida's ecosystem have experienced appreciable impact since Flagler's railroad arrived in Miami in 1896, and initiated the region's development process. How development affected the use of land is key to understanding this impact.

Limitations in the Economic Theory of Land Use

Anthropogenic changes in land cover and land use, and the environmental problems that arise as a result, are mainly driven by the desire to use land as a factor in the production of agricultural goods and residential amenities. The theory of land use—if not land-cover and land-use change—is well developed in this regard. The prime contribution stems from von Thünen and the concept of *bid-rent*, the maximum amount a renter is willing to pay for the use of land. Bid-rent, highly conditional on transportation costs to product and labor markets, has been applied to agriculture (von Thünen 1966; Dunn 1954; Isard 1956), to urban form (Alonso 1964; Muth 1969; Casetti 1971; Mills 1972a and 1972b; Solow 1973), to nonuniform transportation networks (Muth 1969), to the disutility of commuting (e.g., Beckman 1974), to family structure (e.g., Beckman 1973), to social stratification (Wheaton 1978), and to multiple CBDs (Fujita and Krugman 1995).

Despite these many applications, bid-rent theorists have paid little attention to empirical assessments of land-cover and land-use change. Be this as it may, statistical modelers addressing the issue do recognize the importance of bid-rent, and, in particular, its link to transportation costs, as a factor affecting change. Chomitz and Gray (1996) and Walker and Solecki (1999) elaborate a concept of *potential* rent, which becomes actual rent the moment new infrastructure lowers transportation costs, or makes land newly available for exploitation. As such, potential rent is the incentive driving speculative land acquisitions in areas about to be "developed." Chomitz and Gray (1996), Nelson and Hellerstein (1997), and Wear and Bolstad (1998) refer explicitly to von Thünen in defining accessibility variables for estimation purposes, and a robust result in the statistical work to date is that accessibility—taken as some measure of distance and transportation costs from a parcel of land to a road, a market, a city, or a region—is strongly linked to the likelihood of land-cover and land-use change.

The Equilibrium Assumption

Although the importance of accessibility to landscape change processes has all the appearances of a truism, bid-rent theory has been criticized by social theorists and economists alike for its inability to account for both historical and more immediate change processes, due to the equilibrium assumption made in the interest of model tractability (Page and Walker 1994; Bockstael 1996). Since land-cover and land-use change and region-scale resource exploitation are inherently dynamic, they reflect disequilibria, a conceptual category absent from the bid-rent formulation. It would appear self-evident, then, that the classical model cannot hope to describe the transformative forces unleashed on the landscape and the resource base by development.

Nevertheless, the limitation of the von Thünen approach as ahistorical and requiring the land-use system to be at equilibrium can be overcome, it is argued here, by considering the links between model structure and underlying system parameters. This may be demonstrated with the structural variable *fringe-distance*, the maximum distance at which urban or agricultural land is observed from the market center in the urban and the agricultural models, respectively. In other words, fringe distance is the point at which rents are effectively driven to zero due to transportation costs. If natural areas lie beyond this point, then expansion of the fringe can be interpreted as a land-cover dynamic, in this case the encroachment of human land-use (urban or agricultural) into natural areas.

As it turns out, specific model solutions—with respective fringe distances— reflect parameter values that depict specific system structures. The parameters, such as transportation costs, population, income level of the local area residents, and consumer preferences, change over time as the process of development unfolds. If fringe distance is stated as a function of these parameters, then different land-use equilibria associated with evolving parameter values describe a long-run landscape dynamic (Walker, Solecki, and Harwell 1997; Walker 2001). In such a situation the equilibrium model can be used to shed light on the disequilibrium process.

The bid-rent formulation possesses more serious shortcomings than that associated with the equilibrium assumption. These are attributable to (1) the economic structure and external linkages of the modeled system and to (2) the agent behavior that underpins model formulation. Each of these problems will now be considered.

Economic Structure and Linkage

One obvious and surprising limitation of the formal bid-rent formulation is the lack of structural linkages between city and hinterland, despite recognition of their importance (Sinclair 1967; Katzman 1977; Cronon 1991). Generally, urban models focus only on urban land use, and agricultural models, on farming. The practical implication is that modeled *reality* is at odds with the way in which cities and farmlands occupy space. The von Thünen farm model collapses the city into a dimensionless point, while the city model assumes either no agricultural land use whatsoever or an unbounded extent (Fujita 1989). The independent statement of the agricultural and urban model also fails to reflect key linkages between city and hinterland that have played major roles in ecological transformation over large regions (Cronon 1991; Walker 2001). Land-cover and land-use change result from economic and demographic interactions between city and hinterland as well as from specifically agricultural and urban processes.

Besides the independent nature of the agricultural and urban model statements, the land-use theory associated with the bid-rent paradigm is highly circumscribed spatially. Although von Thünen has been used to describe frontier evolution in large regions (Katzman 1977; Cronon 1991), formal applications of the modeling framework focus on specific places, which is consistent with the role that local product and labor markets play in the theory of bid-rent. This represents a partial spatial equilibrium that neglects critical trade relationships among cities and regions. Further neglected are factor movements, especially labor migration. Factor flows and trade among cities and across spatial scales presumably alter land use in the regions associated with the cities, and consequently, broad-scale processes of landscape change result from city impacts on specific hinterlands as well as from the economic and demographic linkages connecting the cities to each other (Solecki 2001).

The Land-Cover Change Agent

Beyond these structural issues, another shortcoming of bid-rent theory is the conceptualization of the land-using agent, who is typically a farmer or a residential consumer of land, acting independently in a competitive bidding process. This has little to do with the actual process of altering land cover from one type to another, which involves a wider variety of agents and more rapacious behaviors. Individuals taking down tropical forest, for example, vary by continental region and include government bureaucrats, loggers, shifting cultivators, commercial farmers, ranchers, fuel wood gatherers, and urban developers, many of whom act interdependently in logical *tandems* (Myers 1980; Hecht 1985; Geist and Lambin 2002). In the case of South Florida, farmers, land speculators, government bureaucrats, and politicians all played their parts in a complex, long-term process of wetlands reclamation.

Moreover, agent behaviors in the bid-rent formulation are quite different from land-cover change behavior, particularly at the extensive margin of agriculture where natural lands are under conversion to human use, as in deforestation frontiers. Here, speculation is common, as is desperate response to economic deprivation. Those who initially transform a natural landscape—from forest, swamplands, or prairies—are often the rent seekers themselves and not the people who allocate the land afterwards with competitive bids and sustain a narrow focus on agricultural production or residential utility.

A critical limitation of formal bid-rent theory in this regard is that it does not address the higher order actions that precipitate changes in important system parameters through infrastructure investment, a decisive part of the South Florida story, as well as tropical deforestation (Hecht 1985; Simmons 2002). Such behavior, largely of a bureaucratic nature, is what creates potential rent by radically lowering transportation rates, or by making arable land where once was only marsh. And such behavior, in turn, is highly influenced by the forces of development and the discourses that legitimate development in the first place. While bid-rent models provide insight into the effect of a reduction in production or transportation costs on the extensive margin of agriculture, they say nothing about how these reductions occur or how large they will be. This part of the story is the province of structural and post-structural analyses that enable the detailed examination of contextual conditions through which land-cover and land-use change take place.

Bringing Theory to the South Florida Case

Urban-Rural Interactions in Production and Land-Use

Initially, the classic bid-rent model appears limited in providing theoretical descriptions of land-cover and land-use change processes. Recently, Walker (2001) has merged von Thünen with the urban model of Alonso (1964), specifically to address changing regimes of natural areas encroachment in South Florida. The model overcomes the limitation of independent statements of agricultural and urban land use. In this, it is reminiscent of early formulations by Muth (1961), who considers the conditions under which cities expand at the expense of farmland, and Sinclair (1967), who addresses the impacts of urban sprawl on agricultural land use. The Walker model differs by taking into account natural areas encroachment in addition to sprawl, as well as structural linkages between urban and agricultural economies similar to those noted by Cronon (1991).

Walker (2001) hypothesizes a two-stage sequence in the linkages between urban and rural sectors. This relationship, in turn, is mainly conditioned by the degree of development in the regional economy. As an example, South Florida's early economic structure based on elite tourism and agriculture initially involved a relatively high degree of *coupling*, defined as the existence of input-output linkages stemming from the local demand for food and supply-side processing of agricultural commodities prior to export. With continuing development, the interdependency of the urban and rural sectors ruptured, rendering a *decoupled* regional system, with separate rural and urban regional economies emerging. Agriculture increasingly served national markets, and the urban economy developed both mass tourism and a wide range of producer services (Nijman 2000).

Walker (2001) hypothesizes that the process of decoupling should show a predictable pattern in the regime of land-cover and land-use change over the long term. The argument is that with a coupled economy, output from the urban sector requires local agricultural production, so city growth pushes agriculture into natural areas, in which case, the loss of natural lands is attributable to agricultural encroachment. Once the city and hinterland are decoupled, city expansion may occur independently of local farming, and urban land-use encroaches directly on natural areas, if necessary. Thus, the historic record for South Florida should show pronounced natural-to-agricultural conversion in early years, followed by a growing component of natural areas loss directly attributable to city growth (natural-to-urban).

A Century of Land-Cover Change

Evidence supporting these hypothetical statements is provided in Table 1, which gives relevant data for three subregions and for four periods, or conversion episodes (1900–1953; 1953–1973; 1973–1988; 1988–1995), determined by data availability. The numbers for 1953,

Table 1a. South Florida Land Cover Dynamics: Natural to Agriculture (N → A), Natural to Urban (N → U), Agriculture to Urban (A → U) Km^2

	Gold Coast[1] = 1			Gulf Coast[2] = 2						Central[3] = 3		
	1900–1953			1953–1973			1973–1988			1988–1995		
	1	2	3	1	2	3	1	2	3	1	2	3
N → A	1518	369	81	2440	787	1509	455	495	607	168	179	273
N → U	576	60	5	872	430	31	597	567	32	166	110	17
A → U	0	0	0	228	108	7	583	146	63	183	54	14

[1] Gold Coast = Broward, Dade, and Palm Beach Counties.
[2] Gulf Coast = Collier and Lee Counties.
[3] Central = Hendry County.

1973, 1988, and 1995 are derived from remotely sensed data, while the 1900 values come from an ecological reconstruction of the predrainage system (Center for Wetlands, University of Florida). The subregions are defined by counties. The Gold Coast consists of Dade, Broward, and Palm Beach counties, while the Gulf Coast consists of Collier and Lee. The central subregion is made up of only one, Hendry county (Figure 1).

Table 1 aggregates land cover and land use to three categories: natural, agricultural, and urban, using the modified Andersen II classification scheme (Anderson et al. 1976). Here, we take "natural" land to be a broad category defined from a variety of indigenous land covers such as sawgrass prairies and forest hammocks. Agricultural land includes cropland and fruit groves, while urban land comprises all residential, commercial, transportation, and industrial uses. The conversion matrix allows for six possible conversions, including loss of natural areas to agricultural use (natural to agriculture) or consumers of residential space (natural to urban). Urban sprawl is typically observed as the conversion from agriculture to urban. Natural areas recovery from urban and agricultural use, not presented in the table, is also evident in the data, but at low levels.

Encroachment by agriculture into natural areas is substantial in the first two episodes across all of South Florida, as shown in the table. Of note, however, is the sharp increment in the second episode, particularly in Hendry County. The Gold Coast also shows a large conversion of natural areas to agriculture during these years, explained in part by Palm Beach County, which shares a large agricultural area with Hendry (the so-called Everglades Agricultural Area [EAA], created in the 1950s by the U.S. Army Corps of Engineers). Through all four episodes, agricultural expansion into natural areas is less pronounced on the west coast than the central and eastern areas. Nevertheless, like the rest of South Florida, Collier and Lee counties show a spike in agricultural encroachment between 1953 and 1973. For the three subregions, direct conversion of natural lands to urban use is relatively low in the first two episodes, but gains ground later. Between 1973 and 1988, more natural land converted directly to urban use than to agriculture in both the Gold Coast and the Gulf

Table 1b. Subregional Total Areas, by County Km^2

Gold Coast		Gulf Counties		Central	
Broward	3155	Collier	5328	Hendry	3015
Dade	5254	Lee	2300		
Palm Beach	5769				
	14178		7628		3015

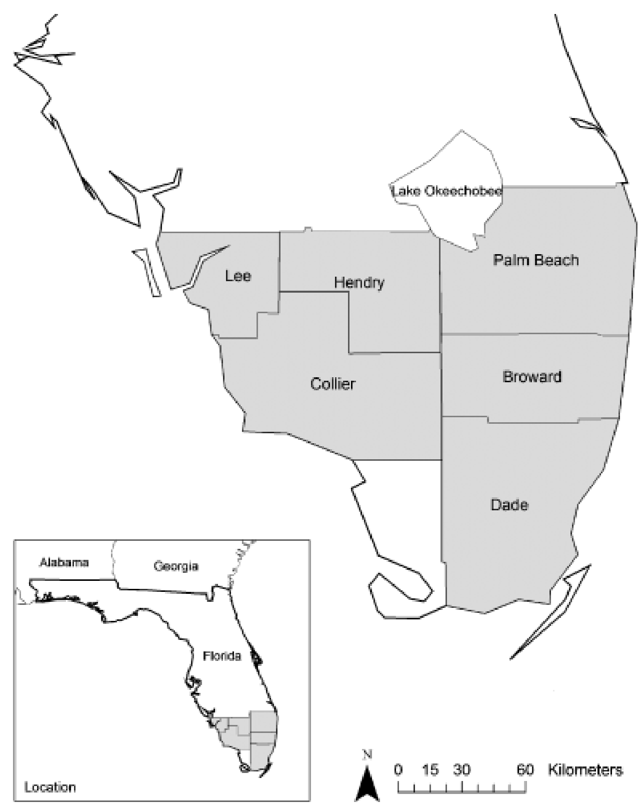

Figure 1. Counties in study area.

Counties, and the numbers remain high in the final episode. In general, the share of natural lands conversion accounted for by transition to urban use tends to increase over the record. Urban "sprawl" is pronounced in the middle two episodes, covering roughly the years between 1950 and 1990.

In absolute terms, these various processes have amounted to an extensive conversion of the natural landscape, as can be observed in Figure 2. The Gold Coast, for example, shows over 4,500 km^2 of natural areas converting to agriculture during the period, a sizeable fraction of the subregion, which covers 14,178 km^2. Direct conversions to urban land use exceed 2,100 km^2. The implication of these losses is that the Everglades itself has been reduced by about 50 percent of its predrainage extent.

While such results are suggestive, Walker's presentation (2001) brushes over an important part of the story of how the changes actually took place. In particular, the development context is largely absent, and the model does not connect to the historic process that governed the use of land, and land cover. To rectify this, it is necessary to provide an account of the development that created the basis for bid-rent in the first place. The narrative that follows reconstructs the broad political economy context in which the events unfolded by focusing on the structures, the agents, and the tools they used (e.g., power relations, discourse, capital) to encourage and foster the conditions of landscape change.

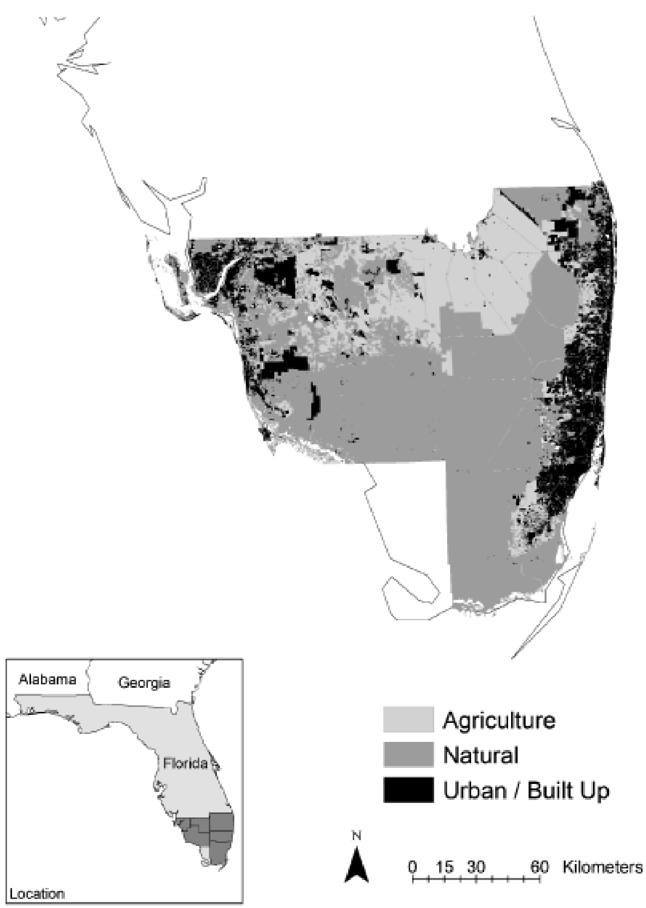

Figure 2. Land-use in South Florida.

The Development Narrative

In the interest of presenting a coherent picture in this regard, the complex history of development in South Florida is organized into a sequence of specific periods, within which the driving forces of environmental change are identifiable and apparently consistent. The approach follows Light and Dineen (1994), McCally (1999), and Solecki (2001). Light and Dineen (1994) describe the episodic nature of infrastructure investments in South Florida starting in the later half of the 19th century. McCally ties infrastructure development to environmental change and bureaucratic agency and dates key social processes such as the consolidation of land holdings. By way of contrast, the narrative presented here specifically addresses wetlands reclamation, economic development, and demographic change in each of three periods. The focus is on the state—in this case, both the State of Florida and federal government—and on specific agents who played roles in the infrastructure investments that paved the way to land-cover change dynamics in the region. The periods considered follow those of Solecki (2001) and consist of frontier closure and initial failures at drainage, development success and articulation of the regional economy, and emergence of metropolis with integration in the global economy. More than just convenient categories, these periods mark points of ecological crisis, in which the mode of capital accumulation is replaced, together with the existing matrix of nature-society relationships (Merchant 1989).

Frontier Closure and the Fantasy of Drainage. The modern economic history of South Florida begins on September 28, 1850, the day the U.S. government passed the Swamp and Overflowed Lands Act and granted 81,000 km^2 of federal land to the State of Florida, about half its sovereign territory.[3] The state quickly put these lands to use and in 1855 created the Internal Improvement Fund (IIF), specifically designed to promote development through land reclamation. The fund functioned mainly by awarding land grants to railroad and canal companies in exchange for their commitment to open new lands for settlement. Although active for many years, the record of the IIF is largely one of financial instability and ultimate failure.

Development did take place, if slowly, but with a social cost. Wealthy businessmen such as Hamilton Disston, Henry Plant, and Henry Flagler gained control over vast tracts of land as well as drainage projects of strategic interest to Florida, despite the populist intention of the original federal land grant (Derr 1989; Carter 1974).[4] In the southern swamps and marshes, very little land reclamation actually occurred under IIF auspices despite much optimistic rhetoric and wishful thinking.[5] Hamilton Disston made an effort along the Caloosahatchee River, but to little effect, draining only 202 km^2 before his business went bankrupt in the panic of 1893 (Tebeau 1971; Blake 1980). Nevertheless, three years later in 1896, Flagler extended his railroad to Miami and succeeded in opening the region.

The arrival of the railroad set off strong development impulses and provided public support for changes in drainage policy that came with the Progressive Era in politics and a much more proactive state role (Colburn 1996). Governors Napoleon Broward and William Jennings intervened, and in 1907 Jennings created a new public agency, the Everglades Drainage District (EDD) to oversee a coordinated program for drainage. Unlike the IIF, the EDD had taxing authority (12 cents per hectare) and was able to sponsor directly the construction of drainage and flood control infrastructure. Between 1906 and 1928, the IIF and EDD together spent about $18 million on drainage and managed to introduce the main features of the current drainage system (Light and Dineen 1994). Another source of state funds came from land sales to companies that then sold thousands of parcels to smallholders, with assurances that drainage would create a rich, agricultural region.[6]

Given inflated expectations about farming potential and energetic promotion by the land companies, the number of landowners in the Everglades rose dramatically, from 12 in 1909 to about 15,000 in 1911 (Solecki 2001). Land prices soared as news spread that an agricultural "paradise" would soon be available for settlement, a misperception stemming in part from claims-making activities of individuals such as James O. Wright, who wrote enthusiastically about the region's potential (McCally 1999; Meindl, Alderman, and Waylen 2002). The partially stabilized and newly accessible environment of South Florida encouraged its first major influx of population, but trouble soon came to the real estate markets when drainage proved more difficult and soils less fertile than first envisioned (Meindl 2000). In addition, devastating hurricanes struck in 1926 and 1928, and by 1931, the IIF was bankrupt, defaulting on payments of mature bonds.

Although these events reduced the pace of infrastructure investment, which did not resume on a massive scale until after World War II (Light and Dineen 1994), it must be emphasized that South Florida's frontier was closing on the eve of economic depression. An incipient economy based on tourism and agriculture emerged in the first 30 years of the 20th century. Prior to Flagler's railroad, few people lived in South Florida outside Key West, and the economy was based on the extractive activities of the so-called Seminole trade in furs, plumes, and hides.[7] This changed dramatically in only a few years, and by 1909, Miami enjoyed 125,000 yearly tourist visits and possessed a permanent population of about 12,500 (Derr 1989).[8] In 1930, the first year census data was collected for the present-day counties, the population for South Florida as a whole reached nearly a quarter of a million (Table 2).

The late 19th and early 20th centuries saw concerted efforts by state government, entrepreneurs, and state boosters to develop South Florida (McCally 1999). The controversial granting of public lands to railroads finally paid off with Flagler, who brought transportation to the region and created its first economy based on tourism and agriculture. Subsequent drainage activities by the State of Florida were insufficient to the task at hand, which was to create usable land beyond the coastal ridge in the wet vastness of the Everglades. Nevertheless, this

Table 2a. South Florida Population, Workforce, and Migration

	1930	1940	1950	1960	1970	1980	1990
Total Population	249819	429427	759605	1623431	2444346	3593868	4647109
% *rural*	22.3	23.7	13.5	9.0	5.1	3.9	4.2
Workforce	111144	199116	302400	606867	942736	1566362	2151006
% *agricultural*	13.6	10.8	7.5	5.0	3.2	2.5	2.4
Migration							
other states				416134	436810	646693	654689
international				41289	122992	146067	221381

Source: U.S. Census for 1930, 1940, 1950, 1960, 1970, 1980, and 1990.

Table 2b. South Florida Employment Profile–1910[1]

Farmers/Farm Laborers[2]	32.5%
Other Primary Industry Workers[3]	2.8%
Transport Workers[4]	5.3%
Hotel Workers[5]	1.2%

[1] Statistics were developed from the 1910 U.S. Census data for Dade County, Florida (which includes current Broward and Dade counties). A systematic sampling regime was employed. Starting with the first entry of each enumeration district every 20th individual was sampled. Individuals who did not list employment were not included. Individuals with employment in the next entry were chosen instead. The total sample was 601 individuals. The census data was accessed via the website Ancestry.com.
[2] Percentage of farm labor is likely to be a lower bound because another 8 percent of workers defined themselves as odd-job laborers. It is assumed that a significant percent of these individuals were likely employed in seasonal agriculture.
[3] Other primary industry workers included those involved in fishing and logging and related raw lumber activities.
[4] Transport workers include those who directed/drove and/or maintained wagons, railroads/trains, trucks, boats, and steamships.
[5] The only employees that specifically mentioned hotel employment were porters.

very failure helped pave the way in the next period for extensive federal intervention, engineering success, and ecological ruin.

Consolidation of the Regional Economy (1930–1970). This period actually begins in economic depression, when little large-scale investment, public or private, occurred in South Florida. Although the State of Florida and entrepreneurs had reclaimed a considerable amount of land for agricultural purposes by the late 1920s, these same lands remained vulnerable to tropical storms, which struck in 1926 and 1928 with considerable loss of life and costly disruptions in cropping cycles. The State of Florida appealed to the deep pockets of federal government for help, and in 1930 work began on the Hoover Dike—a massive levee 3–12 meters high, 40–45 meters wide, and running for 135 kilometers around the southern shores of Lake Okeechobee. Federal support continued with the Flood Control Act of 1936 and the Federal Rivers and Harbors Act of 1937 (Bottcher and Izuno 1994). This new legislation did not bear fruit, however, until the late 1940s when floods struck in 1946 and 1948, inundating the interior agricultural areas as well as coastal residential communities. Local political interest groups representing agriculture and coastal areas quickly united, along with state representatives and the Army Corps of Engineers, to initiate one of the largest water projects ever undertaken, the Central and Southern Florida Project for Flood Control and Other Purposes (Blake 1984).

Although wetlands reclamation remained an important goal, the project signaled the growing interest of local area residents in flood control as opposed to drainage (Light and Dineen 1994). With financial resources of the federal government now in play, the system materialized in relatively short order, considering the history of the IIF and the EDD. The Eastern Perimeter Levee was constructed between 1952 and 1954, the Everglades Agricultural Area, between 1954 and 1959, and the Water Conservation Areas, between 1960 and 1963.[9] In addition, spillways, culverts, and pumping stations were added, through 1973, to improve water conveyance south (Light and Dineen 1994). Once completed, the project consisted of 1159 kilometers (720 miles) of levees, 1609 kilometers (1000 miles) of canals, 200 gates and water control structures, and 16 pumping stations (USACE and SFWMD 2000, 5; Kiker, Milon, and Hodges 2001).

These large-scale improvements sparked major changes in the region, particularly during the postwar years. Earlier decades showed higher growth rates in percentage terms, but between 1950 and 1970, regional population climbed from less than 800,000 to nearly 2.5 million (Table 2). Miami attained the status of a major metropolitan area in the 1960s, as large numbers of migrants arrived from the northeast and midwestern parts of the United States, as well as from other countries. Many of these newcomers were retirees who either moved to the state or visited seasonally as winter snowbirds (Shultz 1991). Rapid growth of the retiree population was the single most important source of economic growth for southeast Florida in the early postwar years, given the discretionary income they carried with their federal transfer payments and accumulated savings (Stronge 1991).

Agriculture also began to show its long awaited promise, as South Florida's transportation and product distribution systems became integrated into northern and midwestern markets, and as strong nonlocal demand for the winter vegetables and fruits grew throughout the nation (Winsberg 1991). Between 1949 and 1977, South Florida greatly expanded vegetable sales, supplying 9 percent of the national market by 1977. Agriculture was also stimulated by the Cuban Revolution in the late 1950s. With Castro's rise to power, the U.S. government eliminated, in 1960, the quota that had given Cuba ready access to U.S. markets, thereby sparking rapid growth in domestic sugar production (Alvarez and Polopolus 1988). In 1959, only about 190 km^2 of sugarcane were harvested in the Everglades Agricultural Area (EAA). This area grew considerably through the 1970s, ultimately increasing by an order of magnitude (Snyder and Davidson 1994).

Like agriculture, tourism also developed dramatically. In the early 20th century, the American tourist was often a wealthy individual, and those visiting South Florida were no exception. In particular, they needed enough discretionary income to pay for a railroad ticket and accommodations at the upscale hotels of the era, where they stayed during a relatively short winter season. After World War II, the industry changed focus to the middle-class individuals who came by car in both winter and summer, and the number of visitors rose precipitously.

Consolidation of the regional economy was secured with federal involvement in mitigating the region's floods. Ultimately, state boosters, local politicians, and wealthy individuals were unable to marshal the financial resources necessary to tame the hydrology and to ensure the creation of safe, arable land. To accomplish this, $5 million of mostly federal funds had to be spent (Finkl 1995). With land now available in a part of the country made attractive with innovations such as the air conditioner and mosquito control, state and local officials, working with mainly local developers, were able to promote growth at an unprecedented scale. The dreams of Hamilton Disston and the land speculators came to fruition in the desiccating muck-lands of the Everglades. Of course, the seeds of environmental crisis had been planted in the very soils that now contributed to the region's economic success.

Globalization (1970–present). Although visionaries recognized the ecological treasures of South Florida in the early years (Douglas 1947), widespread awareness of environmental decline did not seep into public consciousness until well into the postwar period, when it became apparent that continued wetlands reclamation and excessive water management in the interest of flood control would forever alter the region for the worse (Kiker, Milon, and Hodges 2001). This profound change in public perceptions ultimately provided political support for the Comprehensive Everglades Restoration Plan, today's effort to reengineer the region's hydrology and environment in order to restore as much as possible, given irreversible wetlands loss, the natural system to predevelopment conditions (National Research Council 2003a, 2003b). The restoration, in turn, signals a refocusing of the regime of accumulation, away from rents obtainable through subsidized land creation, and in the direction of high profits in international banking and producer services (Nijman 2000).

Through much of the 20th century, newly available land sparked substantial in-migration of domestic origin and facilitated the development of the region's tourist and agricultural economies. In turn, local area residents, especially those whose livelihoods were tied to land speculation, promoted, or at the very least supported, wetlands reclamation and hydrologic intervention. In the 1960s this land-based development process dissipated, due in part to growing awareness of environmental dysfunction but also because links between land reclamation and economic expansion unraveled. Ongoing globalization of the national economy and massive waves of Latin American immigration, following liberalization of immigration laws in 1965, fundamentally altered the economic landscape of the region.[10] In-migration from Latin America also brought changes to the established political order, as the social and economic fabric took on postmodern fractures and complications (Croucher 1997; Nijman 2000). The new Hispanic residents pursued their own agendas focused on employment, political representation, cultural values, and community issues (Croucher 1997; Moore 1994; Portes and Stepick 1993). Ethnic and racial tensions and loss of environmental amenity brought on by dramatic population growth ultimately affected tourism, the lynchpin of South Florida's original economy. Be this as it may, South Florida's geographic placement and internationalized resident populations transformed Miami into the "capital of Latin America," a major North-South center of business activity, international finance, and capital flow (Nijman 1996, 2000).

Although concerns of the coastal urban populations now have little to do with land development or the environment, the accumulated weight of wetlands reclamation and agricultural development in the region sparked political reaction in 1988, with the filing of a federal suit against the State of Florida and the South Florida Water Management District for failing to stop the flow of eutrophic waters into Everglades National Park (John 1994). In reaction, the South Florida Ecosystem Restoration Task Force was formed, with representatives from federal and state agencies, Indian tribes, and South Florida counties. Perhaps ironically, given its role in creating the problem in the first place, the Army Corps of Engineers was tasked by Congress to evaluate the Central and Southern Florida Project and to develop a plan for an environmental clean-up (USACE and SFWMD 2000, 2; Kiker, Milon, and Hodges 2001).

The response by Federal and State Government was swift. The Water Resources Development Act of 2000 (Public Law No. 106-541, Title VI, Section 601) and the Everglades Restoration Investment Act (Florida Statutes, Section 373.470) authorized the Corps to implement its plan. International and national environmental NGOs energized their South Florida chapters, and the Everglades Partnership was formed bringing together local, state, and national public agencies, as well as

NGOs (nongovernmental organizations), all devoted to Everglades restoration (Flicker 1996, 6).

It is too early to assess the outcome of the restoration, which is expected to require decades (Kiker, Milon, and Hodges 2001; National Research Council 2003a). The overall goal is to recreate the ecological integrity of the region by blocking canals to impede unnaturally rapid runoff, by converting key agricultural areas to original wetlands cover, and by land acquisitions meant to amplify current protected holdings. The salient point for the present discussion is that a complete reversal of state and public intention has occurred concerning the region's ecological resources. *Land reclamation* through wetlands conversion is no longer part of the development lexicon, for the environment has been "capitalized" as an essential part of the natural resource base in what may possibly be South Florida's final ecological transformation (Merchant 1989; Escobar 1996).

An Epistemological Space for Bid-Rent?

Critical to deploying the Walker adapted bid-rent formulation to South Florida's environmental change process is use of the historic record and ancillary data to (1) describe how the demand for wetlands reclamation originated and persisted in the region, and to (2) document economic coupling and decoupling. To this end, Figure 3 gives a schematic representation of bid-rent for a "linear" city, with related rent gradients for the traditional urban and agricultural models, respectively (Fujita 1989; Asami, Fujita, and Smith 1990). Here, r_u represents the urban fringe distance, or the maximum extent of urban land-use, while r_a is the comparable measure for agriculture. For the present application, this figure may be interpreted as the view south, in which case, the rent function shows the drop in real-estate values as one heads west, from the beaches of the Gold Coast toward the Everglades wetlands. A symmetric transition could also be depicted from the West Coast, oriented in an easterly direction. The geometry of the figure is a departure from the standard Thünian notion of a circular city with concentric land uses, but is representable by bid-rent theory (Fujita 1989).

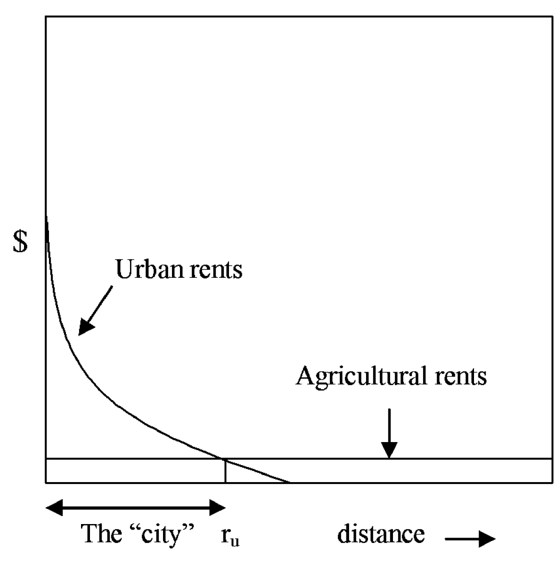

Figure 3a. A "Linear City" following Fujita (1989).

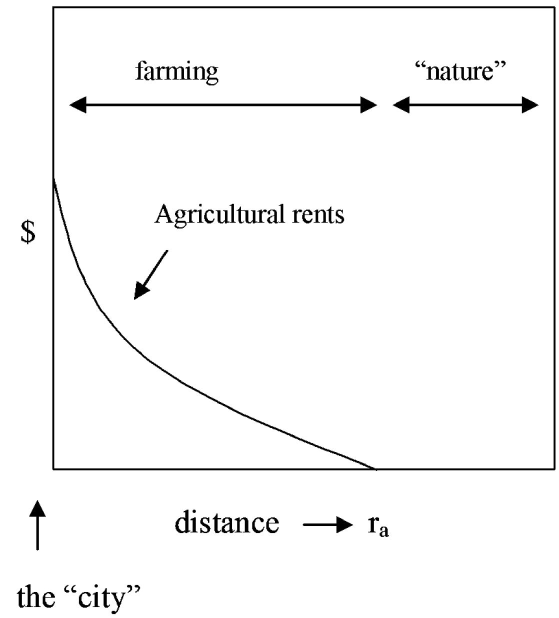

Figure 3b. Von Thünen rents (Fujita, Krugman, and Venables 1999).

The incentives to reclaim wetlands. Expansion of a regional land-use system is problematic in a setting such as South Florida with extensive wetlands. Reclamation is an extremely expensive enterprise requiring substantial investments up front and a long period before returns to capital mature. The protracted nature of the return on investment did not deter the early entrepreneurs, however, who labored under the illusion that drainage would come fast to the region. A number suffered consequences as a result (e.g., Disston committed suicide at the height of his associated financial difficulties), and even the smallholders who came later grew frustrated with the slow pace of drainage.

During the late 19th and early 20th centuries, the political demand for wetlands reclamation rose sharply as farmland came up against the natural barrier of the Everglades, as depicted in Figure 4. This figure also shows the economic motive for reclamation, the potential rents lying beyond the area of cultivation, which presumably become available after drainage. These rents

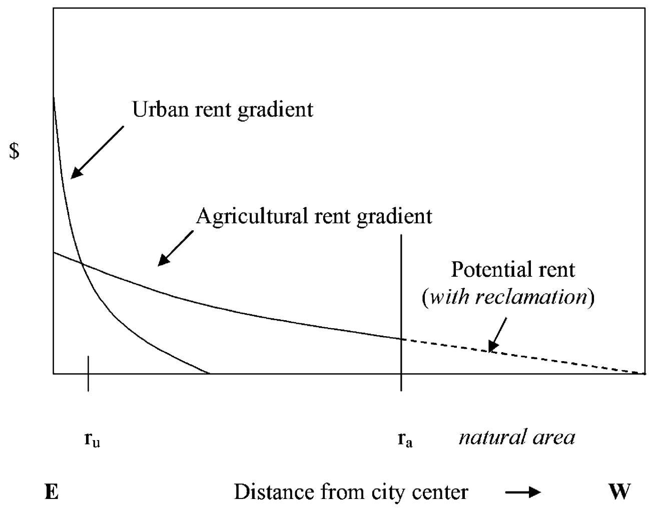

Figure 4. Potential rent.

did not materialize quickly enough to satisfy investors in the early period, given that wetlands reclamation proved more expensive and politically complicated than first imagined. As a consequence, the drainage effort stopped, and only federal dollars finally managed to establish any substantial area of reclaimed land, safe for farming and residential use. These expenditures provided a major subsidy to later entrepreneurs with large landholdings, as well as to the region at large.

Federal government spending is not enough to explain the extent of Everglades encroachment that the region ultimately suffered. The successive waves of migration to the region have been mentioned, and during certain years of the historic record, South Florida showed exceptionally high population growth rates. This is most likely attributable to the emergence of South Florida as a desirable place to live. Air-conditioning and mosquito control enhanced its site utility at the same time that the automobile and reliable jet service opened the region to the rest of the country and significantly reduced internal transportation costs. Such conditions spark interregional migration by virtue of welfare gains obtainable through changes in residential location (Sjaastad 1962) and also unleash strong suburbanization impulses (Fujita 1989).

The process of decoupling. As for the structural dynamic of city-hinterland coupling, anecdotal evidence and census archives provide support for the evolution as depicted, from a coupled to a decoupled state. Clearly, at the present time, the decoupled nature of the urban and rural sectors is a fait accompli, given the sheer size of the regional economy, whose gross domestic product exceeded $80 billion in 1990 (Walker Solecki, and Hodge 1998). Sugar cane, the region's most important crop, is sold on national markets and does not serve strictly local demands (Snyder and Davidson 1994; Mulkey and Clouser 1988). Moreover, total sugar sales approached $500 million in 1990, a miniscule portion of the overall regional economy, even with price supports (Alvarez et al. 1994). Workforce statistics also bear out the minor role of agriculture in the South Florida economy of today, although primary sector employment remains higher than the national average (Table 2).

Initial stages of coupling are more difficult to document. On the demand side, one of the regional attractions for early tourists during the early years was "good food," presumably including certain tropical crops unique to the region (Derr 1989). The transportation system of the time, including steamboat portage of vegetables grown in the Everglades, was simply inadequate to the task of rapid export of perishable goods, although fruit such as pineapples and citrus could make long hauls (Blake 1980). Price volatility for vegetables as late as the 1930s and 1940s has been attributed to competitive national markets (Snyder and Davidson 1994), but may also have reflected variation in tourist visits, given the impacts of depression and war. In any event, the historic record suggests that urban-rural coupling was more pronounced in early years than currently, and that its intensity has diminished over the long run. This is brought out in part by comparing the data in Table 2a to 2b, which show the importance of agriculture to the composition of the 1910 workforce. Presumably, transportation and hotel workers were dependent on the produce of this sector, as were tourists wintering in the region. The high relative number of transportation workers, which drops to 3.1 percent by 1930, is probably linked to the inflow of visitors and the export of certain nonperishable crops such as citrus and pineapple.

Such urban-rural linkages and associated impacts on land cover can be depicted by a bid-rent formulation. In particular, the model developed by Walker (2001) demonstrates that—in a coupled system—urban sprawl and natural areas encroachment take place as regional production becomes increasingly dependent on urban-based services that add value to farm produce.[11] This occurs because farm workers change residence and labor force participation to the city, where demands for residential space expand the urban boundary. However, because the city depends on agricultural production in the coupled version of the model, farmland encroaches on new areas to make up for losses to urban sprawl (Walker 2001). The same result holds for a growing tourist sector, with increasing numbers of visitors and consequent demand for the provision of tourism services.

Figure 5 depicts such an effect, with a shift in the urban rent curve due to increasing residential competition, an expansion of the city at the limit of farming, and a compensating displacement of the agricultural hinterland. When the urban and rural sectors are coupled, natural areas encroachment occurs with the advance of farming, which was largely the case during the early frontier phases in South Florida (Table 1).

The historic record suggests long-run erosion in urban-rural coupling, in which case residential and agricultural demands for land are disassociated from one another. In such a situation, the Walker model shows that if the price for the agricultural commodity does not change as local production diminishes with the loss of farmland (i.e., price is perfectly "elastic"), the agricultural rent function remains fixed, and increasing urban rents expand against agriculture, with no compensating agricultural conversion of natural areas (Walker 2001). In fact, with sufficient urban expansion, due for example to strong in-migration, the city expands past agriculture and directly encroaches on natural lands (Walker et al. 1997; Walker and Solecki 1999). Under decoupled regimes, then, the expectation is that natural areas conversion, when it occurs, is mainly an urban phenomenon (Figure 6).

Other factors do come into play, such as the market situation and public policy. If the price of the good is inelastic due to market structure, then urban encroachment can force crop prices up and elevate the agricultural rent curve (Walker 2001). Public policy may have a similar effect when price supports keep prices for the agricultural good artificially inflated. Thus, natural areas encroachment can remain partly an agricultural phenomenon, even when the urban and rural economies are decoupled, as was the case in South Florida with the expansion of sugarcane through the 1960s (Table 1).[12]

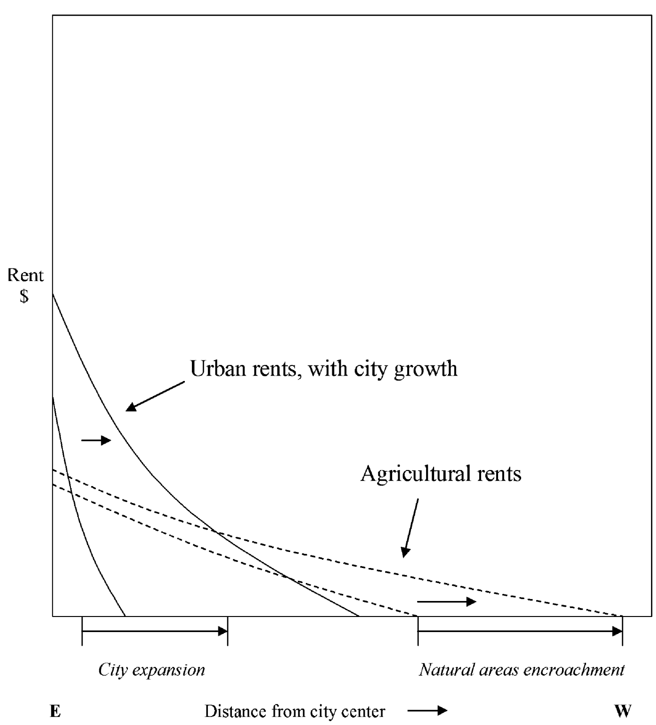

Figure 5. Land cover change with coupled system.

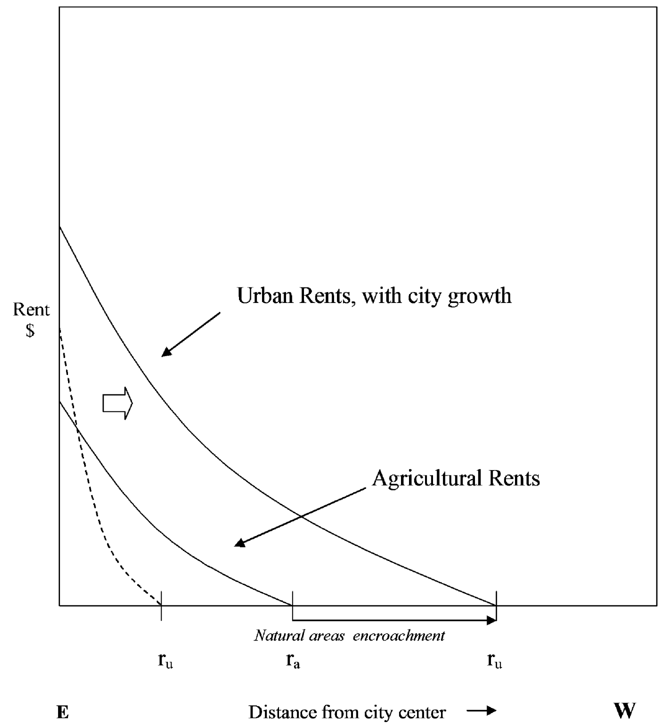

Figure 6. Land cover change with decoupled system.

The current distribution of rent, along a transect south of Lake Okeechobee in the Everglades Agricultural Area (EAA), is given in Figure 7. Of course, residual agriculture can be found on the coastal ridge in what the figure presents as purely urban land use. Similarly, urban land use is found in the agricultural region of the Everglades Agricultural Area. The figure captures the dominant features in either case, however, and also represents the end of the present story. Perhaps ironically, given the criticism of von Thünen's equilibrium assumption, the land-use system is now in relative stasis. The dynamics of capital accumulation appear to have reached a natural impasse in the Everglades, and greater opportunity in the virtual landscapes of international finance, close by in metropolitan Miami. Of course, the future is never certain. Shifts in national agricultural policy stemming from the political situation in Cuba could undermine the South Florida sugar economy and lead to dramatic conversions of canefields to residential space.

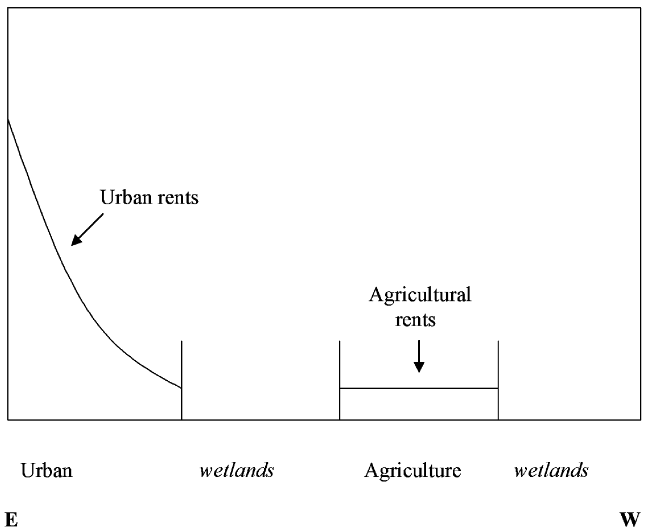

Figure 7. Everglades Agricultural Area: Equilibrium transect.

Conclusions

Before Ponce de Leon began searching for his fabled fountain of youth, South Florida was home to thousands of indigenous peoples and a rich and varied ecology associated with 12,000 km^2 of Everglades wetlands. Now, no one remains of the early indigenous groups, and the Everglades have been reduced by more than half their original extent.[13] We have attempted to explain this process of landscape change and its environmental consequences. In so doing, we consider a recent account in the *Annals* regarding environmental degradation in the region and provide this analysis in the interest of contributing to the development of theory addressing land-cover and land-use change. Two conclusions follow:

Conclusion 1. Clearly, claims making played a decisive role on specific occasions in the formation of South Florida's socionature and its ecological transformations. We call into question, however, the significance of the claims making by James O. Wright to the *entire* process of environmental change. Indeed, claims making begins quite early in the South Florida case, with an initial assessment of the region's agricultural potential by Buckingham Smith in 1848. Although not a drainage engineer, as Meindl, Alderman, and Waylen (2002) point out, Smith was clearly an educated person whose opinions in that day and age would most likely have been granted some degree of credibility. Consequently, his claims making no doubt influenced early efforts at drainage instigated by the Internal Improvement Fund (IIF) and probably contributed to the Herculean fiasco of Hamilton Disston in the 1890s. That particular failure was a significant object lesson to all who later attempted to drain wetlands in South Florida, despite the subsequent claims making of Wright, which itself was heatedly disputed by other competent engineers. Clearly, a number of actors were at work in taking the drainage claims and turning them into cash. We argue that such actors engaged in a multifaceted and protracted effort to realize potential rents through drainage and that drainage is best understood as the consequence of their material actions, legitimated and inspired by discourses dedicated to wetlands reclamation. This brings us to our second, and main, conclusion:[14]

Conclusion 2. In particular, we have attempted to describe the long-run process of land-cover and land-use change in South Florida by embedding a bid-rent framework within the context of political economic explanation. The foundational argument for such an undertaking is that to accomplish robust explanation of the dynamics in question, it is necessary to understand both the mechanics of the land market and the social, economic, and political forces that pave the way to infrastructure investment. Although bid-rent is a controversial concept in certain quarters of the nature-society discourse (Page and Walker 1994), the von Thünen model provides, at the very least, a useful metaphor for city-hinterland relationships (Cronon 1994) and therefore is constitutive of knowledge within the cultural turn of economic geography (Barnes 2000). We suggest that analysts of land-cover and land-use change can go a step further, however, than deploying a useful metaphor in addressing the issues they engage. In particular, the paradigmatic fusion of bid-rent and political economy provides a way to resurrect the ghost of von Thünen with the flesh and blood of social theory.

Acknowledgments

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Notes

1. For an exception, see Jarosz (1993; 1996).

2. The term *Everglades* is often used as a catchall for the region's natural systems, but, in fact, these systems only constitute part of the South Florida environment. The Big Cypress Swamp lies just west of the Everglades marsh and possesses a drainage basin of about 6000 km^2, mostly in Collier county (Carter 1974). Although the Big Cypress was extensively logged in the early part of the 20th century, the most dramatic changes in landcover and ecology have taken place in the Everglades marsh, an extensive system that once covered about 12,000 km^2, much of the land between Lake Okeechobee and the southern tip of the Floridan peninsula.
3. Despite the legislative action, title transfers from the federal government were long delayed and did not occur for the Everglades proper until 1903 (McCally 1999).
4. Early land grants were very large. The Pensacola and Atlantic railroad received 8000 hectares per mile of railroad across the Florida Panhandle. The Gainesville, Ocala, and Charlotte railroad was granted 4000 hectares. Later, Flagler received about 3200 per mile of track (Blake 1980).
5. As early as 1848, the State of Florida had commissioned studies of the agricultural potential of South Florida, when claims making actually begins with the rosy assessment of Buckingham Smith (Blake 1980; Meindl, Alderman, and Waylen 2002).
6. For example, the developer Bolles pledged to buy about 200,000 hectares in 1908 over an 8-year period, at $4.94 per hectare. He deeded 73,000 hectares to his Florida Fruit Lands Company, land that was subsequently subdivided into 12,000 individual farms that were sold by lottery for $250 each, to be paid in monthly installments of $10 (Blake 1980).
7. The Seminole trade generated good income for indigenous hunters at the end of the 19th century (Derr 1989).
8. By about 1900, Palm Beach already had two large hotels, the Royal Poinciana with 1150 rooms, and the Breakers, with 400 rooms (Derr 1989). The Royal Palm of Miami had 450 rooms, and tourist dollars spent yearly probably exceeded $1million (Derr 1989). On the back haul after depositing their well-heeled visitors, the railroads transported tropical fruits north in the two-way trade that was Flagler's original vision (Blake 1980).
9. The levee is an extensive structure just west of the coastal ridge; the Everglades Agricultural Area (EAA) is a drained and diked extent of land (about 4000 km^2) just south of Lake Okeechobee; the Water Conservation Areas are very large water retention and regulation areas west of the levee, and north of Everglades National Park.
10. Since 1970, more than 500,000 individuals have immigrated to the region, bringing their labor power, entrepreneurial skills, capital, and international connections. Augmenting this new resident population has been an upsurge in short-term visitors from Latin America, coming to South Florida as tourists to shop and for recreation.
11. Tourism in South Florida was initially rustic and focused on fishing and hunting. As railroads made the region accessible, visitors—mostly wealthy northerners in the early years—availed themselves of other activities. In that locally grown produce, embellished by hotel chefs, remained necessary to the tourist sector, these new activities, made possible by additional service workers, can be conceptualized as adding value to the units of farm produce that found their way to the dinner table. From the regional development perspective, tourism functions as an export base, given that dollars spent originate from outside the locality providing the tourism service.
12. Alternatively, under a coupled regime, low agricultural suitability of natural lands can predispose them to encroachment by urban, as opposed to agricultural, use. At region scale, a great deal of variability is to be expected in soils and agricultural potential.
13. The main pre-Colombian group was the Calusa. The Seminoles with whom the US government fought three wars were migrants from Creek tribes north of Florida (Swanton 1946).
14. There also appears to be some ambiguity in Meindl, Alderman, and Waylen (2002) regarding the suggestion that claims made by Wright were "wrong." Does "wrong" refer to engineering error, or does it possess a normative ecological sense? That is, was Wright "wrong" in promoting drainage in the Everglades because he misinterpreted rainfall statistics, or because drainage led, over the long run, to ecological crisis? Regarding the first sense of "wrong," it should be pointed out that drainage was ultimately successful in South Florida, if measured in strictly engineering terms. Although this is admitted—somewhat after the fact—by Meindl, Alderman, and Waylen (2002), it does call into question the suggestion that Wright was wrong about the engineering problem because he used rainfall statistics that underestimated the severity of the region's flooding. This suggestion is correct, but in a limited historical sense, for as the Army Corps of Engineers discovered in the 1950s, it was possible to reclaim a great deal of acreage, protect the coastal ridge from floods, and conserve water for urban consumption by constructing the Everglades Agricultural Area, the Perimeter Levee, and the Water Conservation Areas. Wright was wrong, in the final analysis, about the costs of drainage. Regarding the normative notion of "wrong," Wright was clearly also wrong in that he did not foresee or think much about the environmental consequences of drainage. But in this he was no more "wrong" than the vast majority of his contemporaries, all of whom made an ideological contribution to the region's environmental degradation.

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