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An Ecologic Framework to Study and Address Environmental Justice and Community Health Issues

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ABSTRACT

This article builds on environmental justice (EJ) research that examines the differential exposure of disadvantaged populations to environmental hazards and health resources. This article presents a multidisciplinary ecologic framework that postulates macro and meso-level determinants of health are operationalized through segregation and community zoning, planning, and development to create living conditions in urban landscapes. This article promotes the need for a more holistic approach to community health by defining communities as "human ecological systems" with health occurring across a continuum and at multiple scales. By modifying ecologic features of the environment, we can increase the capacity of disadvantaged communities to overcome their exposure to environmental hazards and enhance their access to health resources to achieve environmental justice and improve community health.

INTRODUCTION

TRADITIONAL PUBLIC HEALTH research has explored the contribution of social determinants (i.e., structural racism, poverty), health behaviors (i.e., diet, exercise, alcohol consumption, smoking), and health care access to health disparities in the United States. New research has emerged to examine the contribution of structural and environmental factors to community health and racial/ethnic and socioeconomic health disparities at multiple levels.[1] Focusing on how environmental factors and social conditions and processes interact to drive health outcomes and create health disparities, this body of scientific inquiry is shifting the emphasis from individual level factors to macro and meso-level factors and spatial processes (i.e., segregation, suburbanization, urban sprawl, urban revitalization) to demonstrate the importance of place and environmental context in the examination of environmental justice (EJ) and community health issues. Building on this work, this article provides a comprehensive framework that can be used to address community health issues from an ecological perspective, and to suggest possible interventions to improve community health and reduce environmental health disparities.

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NEW ENVIRONMENTAL JUSTICE TERMINOLOGY

A wealth of literature describes EJ issues that disproportionately burden disadvantaged populations, people of color, and other marginalized groups. A recent report, *Toxic Wastes and Race at Twenty*,[2] provides

[1]Devon Payne-Sturges and Gilbert C. Gee, "National environmental health measures for minority and low income populations: an approach for tracking environmental health disparities," *Environmental Research* 102 (Oct 2006): 154–171; Devon Payne-Sturges et al., "Summary of workshop: connecting social and environmental factors to measure and track environmental health disparities," *Environmental Research* 102 (Oct 2006): 146–153; Gilbert Gee and Devon Payne-Sturges, "Environmental health disparities: a framework integrating psychosocial and environmental concepts," *Environmental Health Perspectives* 112 (Dec 2004): 1645–1653; Rachel Morello-Frosch and Russ Lopez, "The riskscape and the color line: examining the role of segregation in environmental health disparities," *Environmental Research* 102 (Oct 2006): 181–196; M. Soobader M, C. Cubbin, and G.C. Gee, "Levels of analysis for the study of environmental health disparities: the role of place and social theory," *Environmental Research* 102 (Oct 2006): 172–180; Robert J. Brulle and David N. Pellow, "Environmental justice: human health and environmental inequalities," *Annual Review of Public Health* 27 (April 2006): 103–124.

[2]Robert D. Bullard, et al., *Toxic Wastes and Race at Twenty: 1987–2007: Grassroots Struggles to Dismantle Environmental Racism in the United States*. (Cleveland, OH: United Church of Christ, 2007).

insight into racial/ethnic and economic disparities in exposure to hazardous waste sites and other environmental pathogens nationally. Robert Bullard discusses the burden of hazards and noxious land uses in *Dumping in Dixie*[3] and expanded the environmental justice framework to smart growth and transportation planning equity in *Growing Smarter*: *Achieving Livable Communities, Environmental Justice, and Regional Equity*[4] and *Just Transportation: Dismantling Race and Class Barriers to Mobility*.[5] In *Noxious New York*, Sze discusses the history of planning and zoning inequities in New York.[6] While, in *Street Science*, Corburn describes how community-based organizations use their contextual knowledge to address local EJ issues in New York.[7] Pulido, an urban geographer, discusses the role that privilege plays in driving environmental discrimination and spatial disparities in urban development.[8] In addition, the work of Maantay provides additional insight into how discrimination in land use planning and zoning plays a major role in the geographic distribution of environmental hazards.[9] Population health researchers such as LaVeist,[10] Williams,[11] and Lopez[12] describe the role that segregation plays in driving negative exposures to environmental and social determinants of health and health disparities. The innovative work of Gee and Payne-Sturges[13] and Morello-Frosch et al.[14] expands upon this segregation work to show linkages between segregation and environmental health disparities.

I introduce the terms "environmental slavery" and "environmental servitude" as interchangeable conceptualizations that capture the experience of disadvantaged and vulnerable communities whom are differentially exposed to unhealthy environmental conditions and resource-poor settings. Vulnerable communities are used (directly or indirectly) to host social and environmental disamenities and externalities through planning, zoning, industrial siting, infrastructure and development inequities; while communities consisting of dominant racial and class populations benefit from the inequities, access to more amenities, and the ecological goods and services of host communities. There is an underdevelopment and/or destabilization in the growth, health, and quality of life of host communities overburdened by environmental and social externalities and spatially and socially bounded by limited access to environmental amenities.

Moreover, the footprints (ecological, economic, and social) of dominant racial and class populations lead not only to the use of host communities as sinks, but also the use of individual community members as sinks for environmental and psychosocial stressors. Gee and Payne-Sturges[15] indicate that these communities are underserved by health-promoting infrastructure that might otherwise restrict their vulnerability and buffer them from the adverse health consequences of their differential exposure to these stressors and thus are limited in their ability to overcome the cumulative nature of these negative impacts on individual and community-level psyche and well-being over the lifecourse and intergenerationally.

Environmental slavery/servitude is a term that can be used to frame emerging EJ issues that differentially burden people of color, the economically disadvantaged, elderly populations, rural communities, indigenous groups (e.g., Native Americans), women, and immigrants in the US such as climate change,[16] natural disasters,[17] access to health resources including super-

[3]Robert D. Bullard, *Dumping in Dixie: Race, Class and Environmental Quality*, 3rd ed. (Boulder, CO: Westview Press, 2000).

[4]Robert D. Bullard, *Growing Smarter*: *Achieving Livable Communities, Environmental Justice, and Regional Equity*. (Cambridge, MA: The MIT Press, 2007).

[5]Robert D. Bullard and Glenn S. Johnson (eds.), *Just Transportation: Dismantling Race and Class Barriers to Mobility*. (Philadelphia, PA: New Society Publishers, 2007).

[6]Julie Sze, *Noxious New York: The Racial Politics of Urban Health and Environmental Justice*. (Cambridge, MA: The MIT Press, 2007).

[7]Jason Corburn, *Street Science: Community Knowledge and Environmental Health Justice*. (Cambridge, MA: The MIT Press, 2005).

[8]Laura Pulido, "Rethinking environmental racism: white privilege and urban development in Southern California," Annals of the Association of American Geographers 90 (March 2000): 12–40.

[9]Juliana Maantay, "Zoning, equity, and public health," *American Journal of Public Health* 91 (July 2001): 1033–1041.

[10]Thomas A. LaVeist, "Segregation, poverty, and empowerment: health consequences for African-Americans," *Milbank Quarterly* 71 (1993): 41–64.

[11]David R. Williams and Chiquita Collins, "Racial residential segregation: a fundamental cause of racial disparities in health," *Public Health Reports* 116 (Sept/Oct 2001): 404–416.

[12]Russ Lopez, "Segregation and black/white differences in exposure to air toxics in 1990," *Environmental Health Perspectives* 110 (April 2002): 289–295.

[13]Gee and Payne-Sturges, "Environmental health disparities"; Payne Sturges and Gee, "National environmental health measures."

[14]Morello-Frosch and Lopez, "The riskscape and the color line"; Rachel Morello-Frosch and Bill M. Jesdale, "Separate and unequal: residential segregation and estimated cancer risks associated with ambient air toxics in U.S. metropolitan areas," *Environmental Health Perspectives* 114 (March 2006): 386–393; Rachel Morello-Frosch, Manuel Pastor, and James Sadd, "Environmental justice and southern California's 'riskscape': The distribution of air toxics exposures and health risks among diverse communities," *Urban Affairs Review* 36 (March 2001): 551–578.

[15]Gee and Payne-Sturges, "Environmental health disparities."

[16]J. Andrew Hoerner and Nia Robinson, *A Climate of Change: African Americans, Global Warming, and a Just Climate Policy for the US*. (Oakland, CA: Environmental Justice and Climate Change Initiative, 2008); W. Neil Adger, "Scales of governance and environmental justice for adaptation and mitigation of climate change," *Journal of International Development* 13(7) (October 2001): 921–931.

[17]Manual Pastor et al., *In the Wake of the Storm: Environment, Disaster, and Race After Katrina*. (New York, NY: Russell Sage Foundation, 2006). Alice Fothergill et al., "Race, ethnicity, and disasters in the United States: A review of the literature," *Disasters* 23(2) (June 1999): 156–173; Social Sciences Research Council (SSRC). Understanding Katrina: Perspectives from the Social Sciences. Available at: <http://understandingkatrina.ssrc.org/>. Accessed Aug 20, 2008; James R. Elliott and Jeremy Pais, "Race, class, and Hurricane Katrina: social differences in human responses to disaster," *Social Science Research* 35(2) (June 2006): 295–321.

markets,[18] community gardens,[19] parks and playgrounds,[20] pedestrian infrastructure,[21] basic amenities,[22] and medical care facilities[23]; and the overabundance of health-restricting facilities including liquor stores,[24] fast food restaurants,[25] and convenience stores.[26] The term can also be readily applied to describe the state of environmental injustice that burdens groups in the Global South and marginalized racial/ethnic populations in Canada, Europe, and Asia.

The terms *environmental slavery* and *environmental servitude* and the conceptual framework presented in this article (see next section) stem primarily from insight I gained during participatory action research (PAR) and EJ advocacy in North Carolina and other states. Steve Wing's PAR collaboration with Gary Grant, Director of the Concerned Citizens of Tillery and NCEJN President on industrial hog farming,[27] inspired my spatial and exposure assessment research [28] and participation in the community-driven activities of the Rural Empowerment Association for Community Help (REACH) on the topic. The footprints of pathogenic industrial hog farms disproportionately impact the health of local residents (many of whom are poor and people of color) and reduce environmental quality without any reciprocal social or economic benefits accrued by host neighborhoods.

For eight years, I have worked on PAR projects with the West End Revitalization Association (WERA), a community-based organization on built environment, transportation planning, inequities in community planning and development, and infrastructure disparities in Mebane, NC.[29] WERA began a campaign called the Basic Amenities Movement (BAM), developed the community-owned and managed research (COMR) approach, and constructed a multi-stakeholder collaborative partnership to address the aforementioned issues.[30] WERA's work has expanded the EJ lexicon to include resource and infrastructure disparities in underserved communities. The is-

[18]Kim Morland, Steve Wing, and Ana Diez Roux, "Neighborhood characteristics associated with the location of food stores and food service places," *American Journal Preventive Medicine* 22(1)(2002): 23–29; Kim Morland K, Ana Diez Roux, Steve Wing, "Supermarkets, other food stores, and obesity: the atherosclerosis risk in communities study," *American Journal of Preventive Medicine* 30(4) (2006): 333–339; Shannon Zenk et al., "Neighborhood racial composition, neighborhood poverty, and the spatial accessibility of supermarkets in Metropolitan Detroit," *American Journal Public Health* 95(4) (2005): 660–667; Latetia Moore and Ana Diez Roux, "Associations of neighborhood characteristics with the location and type of food stores," *American Journal Public Health* 96(2) (2006): 325–331.

[19]Robert Gottlieb and Andrew Fisher, "Community food security and environmental justice: searching for a common discourse," *Agriculture and Human Values* 13(3) (June 1996): 23–32; Laura Saldivar-tanaka and Marianne E. Krasny, "Culturing community development, neighborhood open space, and civic agriculture: the case of Latino community gardeners in New York City," *Agriculture and Human Values* 21(4) (Jan 2004): 399–412.

[20]Latetia Moore et al., "Availability of recreational resources in minority and low socioeconomic status areas,"*American Journal of Preventive Medicine* 34(1) (2008): 16–22; E. Talen and L. Anselin, "Assessing spatial equity: an evaluation of measures of accessibility to public playgrounds." *Environment and Planning* A 30 (1998): 595–613; Jennifer Wolch, John P. Wilson, Jed Fehrenbach, "Parks and park funding in Los Angeles: an equity mapping analysis." *Urban Geography* 26(1) (Jan–Feb 2005): 4–35.

[21]M. Greenberg and J. Renne, "Where does walkability matter the most? An environmental justice interpretation of New Jersey data," *Journal of Urban Health* 82(1) (2005): 90–100; Wendell C .Taylor et al., "Environmental justice: obesity, physical activity, and healthy eating," *Journal of Physical Activity and Health* 3(Suppl 1) (2006): 30–54; Wendell C. Taylor et al., "Obesity, physical activity, and the environment: is there a legal basis for environmental injustices?" *Environmental Justice* 1(1): 45-48.

[22]Sacoby M. Wilson, Omega R. Wilson, Chris D. Heaney, and John Cooper, "Community-driven environmental protection: reducing the P.A.I.N. of the built environment in low-income African-American communities in North Carolina," *Social Justice in Context* (Accepted for Publication); Sacoby M. Wilson, John Cooper, Chris D. Heaney, and Omega Wilson, "Built environment issues in unserved and underserved African-American neighborhoods in North Carolina," *Environmental Justice* (Accepted for Publication); Sacoby M. Wilson, Omega R. Wilson, Chris D. Heaney, and John Cooper, "Use of EPA collaborative problem-solving model to obtain environmental justice in North Carolina," *Progress in Community Health Partnerships: Research, Education and Action* 1(4) (2007): 327–338; Chris D. Heaney, Sacoby M. Wilson, Omega R. Wilson, "The West End Revitalization Association's Community-Owned and -Managed Research Model: development, implementation, and action," *Progress in Community Health Partnerships: Research, Education and Action* 1(4) (2007): 339–350.

[23]K. Fiscella, P. Franks, M.R. Gold, and C. M. Clancy, "Inequality in quality: addressing socioeconomic, racial, and ethnic disparities in health care," *Journal of the American Medical Association* 283 (2000): 2579–2584; K. Fiscella and D.R.Williams, "Health disparities based on socioeconomic inequities: implications for urban health care," *Academic Medicine* 79(12) (2004): 1139–1147.

[24]T. LaVeist and J. Wallace, "Health risk and inequitable distribution of liquor stores in African American neighborhood," *Social Science and Medicine* 51(4) (2000): 613–617; J. Romley et al., "Alcohol and environmental justice: the density of liquor stores and bars in urban neighborhoods in the United States," *Journal of Studies on Alcohol and Drugs* 68(1) (Jan 2007): 48–55.

[25]Morland et al., "Neighborhood characteristics"; Morland et al., "Supermarkets, other food stores, and obesity"; Moore and Roux, "Associations of neighborhood characteristics."

[26]Morland et al., "Neighborhood characteristics"; Morland et al., "Supermarkets, other food stores, and obesity"; Moore and Roux, "Associations of neighborhood characteristics."

[27]Steve Wing et al., "Integrating epidemiology, education, and organizing for environmental justice: community health effects of industrial hog operations," *American Journal of Public Health* 98 (Aug 2008): 1390–1397; Steve Wing, Dana Cole, and Gary Grant, "Environmental injustice in North Carolina's hog industry," *Environmental Health Perspectives* 108 (March 2000): 225–231; Steve Wing et al., "Community-based collaboration for environmental justice: south-east Halifax environmental awakening," *Environment and Urbanization* (8) (Oct 1996): 129–140; Steve Wing and Susanne Wolf, "Intensive livestock operations, health, and quality of life among eastern North Carolina residents," *Environmental Health Perspectives* 108 (March 2000): 233–238.

[28]Sacoby M. Wilson and Marc L. Serre, "Examination of atmospheric ammonia levels near hog CAFOs, homes, and schools in Eastern NC," *Atmospheric Environment* 41(23) (2007): 4977–4987; Sacoby M. Wilson and Marc L. Serre, "Use of passive samplers to measure atmospheric ammonia in a high density industrial hog farm region in Eastern NC," *Atmospheric Environment* 41(28) (2007): 6074–6086; Wilson et al., "Environmental injustice and Mississippi hog industry," *Environmental Health Perspectives* 110 (suppl 2) (2002): 195–201; Sacoby M. Wilson, *Monitoring and spatiotemporal mapping and estimation of atmospheric ammonia levels near hog CAFOs and human receptor sites in eastern NC*. Doctoral Dissertation. Department of Environmental Sciences & Engineering, University of North Carolina, Chapel Hill, NC, 2005.

sue of basic amenities can be found in urban, semi-urban, and rural neighborhoods across the US, Native American communities, and in the Global South.

My experience with NCEJN, industrial hog farming, WERA, and the Rogers/Eubanks Neighborhood Association (RENA), another NC EJ organization addressing the lack of basic amenities and landfill issues near Chapel Hill, NC, and advocacy work with groups such as Growing Hope and Our Kitchen Table (OKT) on food justice issues in Michigan has contributed significantly to my understanding of: 1) how segregation and community planning, zoning, and development can act as spatial drivers of inequality; 2) how environmental slavery/servitude is manifested in urban, semi-urban, and rural communities; and 3) the need for community members to lead the movement for change and social action.

INTRODUCTION OF A CONCEPTUAL FRAMEWORK TO ADDRESS ENVIRONMENTAL JUSTICE AND HEALTH ISSUES

We need a more holistic framework which takes an ecological systems approach to community health, incorporates spatial and temporal concepts on the social organization of our living environments, considers ecologic features of the built and social environments that influence health, and utilizes contextual expertise to address environmental justice and health issues at the community level. Figure 1 classifies communities as human ecosystems, analogous to living, breathing organisms, whereby the overall health of the human ecosystems influences the health of the populations and individuals who are part of the biotic components of the system. Using this approach, we move away from viewing health in a vacuum and reductionism to placing health of populations and individuals in the context of their community ecosystems. By modifying the health and quality of the structures and living conditions that constitute the community ecosystem, we can modify the health outcomes, well-being, and quality of life of populations and individuals within different community ecosystems.

The upper section of Figure 1 lists macro- and meso-level structural factors that have an impact on the quality of living conditions in human ecosystems. Acting as fundamental determinants that influence health at the community, population, and individual levels, these structural factors operate through multiple spatial and temporal pathways and processes that influence "good health" and "ill-health" and access to the resources necessary both to maintain health and to prevent disease in human ecological systems. To examine how the spatial processes of segregation and community planning lead to the uneven development of communities at the regional and local levels, this framework takes an ecological approach. We can investigate the degree of "health" in communities based on the number and quality of health-promoting and health-restricting structural features, which interact across multiple dimensions of physical, social, political, and economic organizations to form each community ecosystem.[31]

The framework demonstrates that institutional discrimination and racism, differences in political power, socioeconomic inequality, housing policy, economic systems and development, and investment flows and patterns operate through and drive processes of racial, economic, and residential segregation and community planning, zoning, and development. This leads to the construction of human ecological systems populated with different sociodemographic groups. The way that systems vary in the quality of living conditions, including the built, natural, and social environments, and health promotion and prevention (e.g., health care infrastructure, public health agencies, social service organizations), has implications for achieving environmental justice, improving community health, and eliminating exposure, resource, and health disparities.[32]

The uneven nature of economic development, application of fair housing policies, and opportunity infrastructure in education and employment act as important drivers of creating and sustaining unhealthy segregated communities characterized by the accumulation of locally unwanted land uses.[33] Additionally, this uneven application of basic opportunities limits the development and maintenance of health-promoting infrastructure in these segregated communities. The present-day spatial processes of segregation and unevenness in healthy planning and development in and across communities with diverse racial, ethnic, and socioeconomic populations stem from conditions and policies in different time periods (i.e., Jim Crow policies in the South, limited access to low-interest home loans in the post WWII era for non-whites, exclusionary zoning, racial covenants, redlining).[34]

In a more recent time period, "new urbanism," smart growth," and "urban revitalization" have been adopted by planners, local governments, architects, and environmental organizations as approaches to improve health, sustainability, and quality of life in community ecosys-

[29]Wilson et al., "Community-driven environmental protection"; Wilson et al., "Built environment issues"; Wilson et al., "Use of EPA collaborative problem-solving model"; Heaney et al., "The West End Revitalization Association."

[30]Wilson et al., "Community-driven environmental protection"; Wilson et al., "Built environment issues"; Wilson et al., "Use of EPA collaborative problem-solving model"; Heaney et al., "The West End Revitalization Association."

[31]Amy J. Schulz, et. al., "Social and physical environments and disparities in risk for cardiovascular disease: The Healthy Environments Partnership conceptual model," *Environmental Health Perspectives* 113 (Dec 2005): 1817–1825; Amy J. Schulz and Mary E. Northridge, "Social determinants of health: implications for environmental health promotion," *Health Education and Behavior* 31 (2004): 455–471.

[32]Sandro Galea and David Vlahov, "Urban health: evidence, challenges, and directions," *Annual Review of Public Health* 26 (April 2005): 341–365; Nicholas Freudenberg, Sandro Galea, and David Vlahov, "Beyond Urban Penalty and Urban Sprawl: Back to Living Conditions as the Focus of Urban Health," *Journal of Community Health* 30 (Feb 2005): 1–11.

[33]Sacoby M. Wilson, Malo Hutson, and Mahasin Mujahid, "How planning and zoning contribute to inequitable development, neighborhood health, and environmental injustice," *Environmental Justice* (Accepted for Publication).

[34]Wilson, Hutson and Mujahid, "Planning and Zoning."

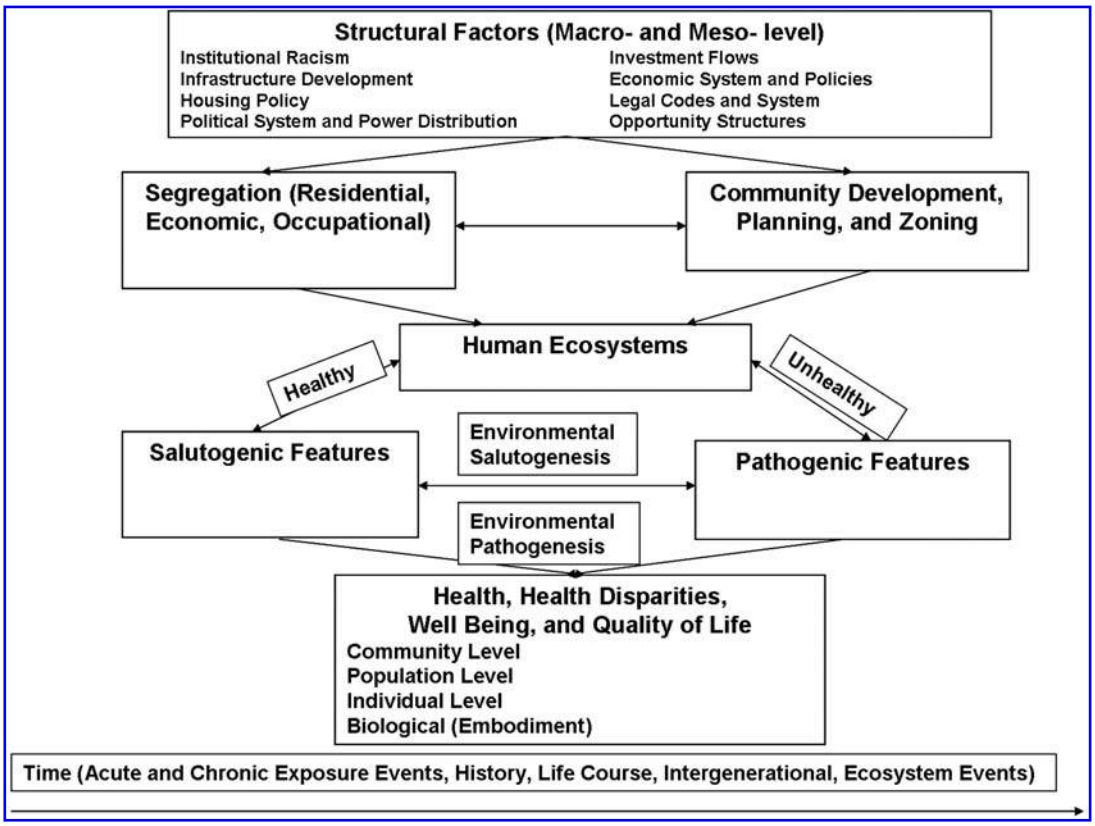

FIG. 1. Ecologic Framework to Study and Address Environmental Justice and Community Health Issues.

tems found in urban environments. Unfortunately, without the infusion of principles of equity and justice to ensure that racial/ethnic and low socioeconomic status (SES) populations who reside in urban communities benefit from these planning approaches, more segregation, gentrification, and uneven planning, zoning, and development may occur.[35]

For example, the negative social, economic, environmental, and health impacts of urban revitalization on disadvantaged populations are evident in the transformation of core urban neighborhoods in major metropolitan areas. Thus, the populations who benefited disproportionately from the suburbanization movement may be the same populations who benefit from "new urbanism," "smart growth," and "urban revitalization," with the opposite effect for historically disadvantaged populations. The overall quality of built and social environments results from the temporal (e.g., intergenerational) and geographic accumulation of structural inequities operationalized through segregation and community planning and development that produce unhealthy community ecosystems (UCEs) which differentially burden disadvantaged populations.[36]

Human ecological systems conceptualization

I have adapted concepts from the field of human ecology, particularly Hawley's *Human Ecology: A Theory of Community Structure*,[37] and the more contemporary work of Dunlap in *Sociological Theory and the Environment: Classical Foundations, Contemporary Insights*[38] and Stokol's work,[39] to provide the foundation of the framework by establishing the linkage between human society and the environment (social, built, and physical) and the bidirectional influences of the two upon each other. Additional insight into how we should organize our human ecosystems and promote health by focusing on prevention comes from cross-disciplinary population health work of several authors including

[35]Wilson, Hutson and Mujahid, "Planning and Zoning."

[36]Mindy T. Fullilove, *Root Shock: How Tearing up City Neighborhoods Hurts America, and What We Can Do About It*. (New York: One World/Ballantine Books, 2004); Mindy T. Fullilove, "Root shock: the consequences of African American dispossession," *Journal of Urban Health* 78 (March 2001): 72–80; Wilson, Hutson and Mujahid, "Planning and Zoning."

[37]Amos H. Hawley, *HUMAN ECOLOGY: A Theory of Community Structure*. (New York, NY, The Ronald Press Co., 1950).

[38]Riley E. Dunlap et al., *Sociological Theory and the Environment: Classical Foundations, Contemporary Insights*. (Lanham, MD, Rowman and Littlefield, 2002).

[39]D Stokols et al., "Increasing the health promotive capacity of human environments," *American Journal of Health Promotion* 18(1) (Sep–Oct 2003): 4–13; D. Stokols, "Establishing and maintaining healthy environments. Toward a social ecology of health promotion," *American Psychology* 47(1) (Jan 1992): 6–22.

Galea,[40] Freudenberg,[41] Vlahov,[42] and Schulz.[43] The ecological framework also builds upon the work of Gee and Payne-Sturges[44] and Morello-Frosch et al.[45] who both have brought attention to the contribution of structural factors and segregation in driving environmental health disparities.

In the case of community health, we should integrate principles and concepts found in the fields of human and social ecology, population health, and environmental health to conceptualize our communities as "human ecological systems" or "community ecosystems." This systems approach allows us to measure the health of the overall community first by focusing on environmental conditions. Community ecosystems with negative environmental conditions can lead to adverse health outcomes, drive bad health behaviors, and result in unhealthy lifestyles for populations within the ecosystems. Conversely, living in community ecosystems with positive environmental conditions leads to good outcomes across the health continuum and lifecourse, modulation of health behaviors, and results in better lifestyles.

Furthermore, the time dimension is a very important element of the framework. The health of human ecosystems is impacted by different temporal events. Thus, to understand how community ecosystems are constructed, maintained, and undergo different states or transitions, temporal processes must be a part of the equation. Individuals, populations, and human ecosystems can undergo acute and chronic exposure events that may lead to positive or negative health outcomes particularly over the life course. Human ecosystems can undergo transformations due to acute temporal events such as natural or man-made disasters or more sustained events such as deindustrialization, suburbanization, revitalization, and the erosion of urban landscapes caused by poverty and other community stressors. These events may catalyze the accumulation of risks and disamenities and lead to the production of unhealthy ecosystems.

ENVIRONMENTAL SALUTOGENESIS AND PATHOGENESIS

The degree of "health" or "disease" in a community ecosystem is partially driven and sustained by environmental salutogenesis and pathogenesis in these community ecosystems. The term "salutogenesis" comes from Antonovsky's *Unraveling the Mystery of Health: How People Manage Stress and Stay Well* (1987)[46] and its meaning has been expanded by MacDonald's *Environmental for Health: A Salutogenic Approach* (2005).[47] Salutogenesis means "the creation or formation or origins of health," while pathogenesis means "means the creation or origins of disease." Antonovsky coined the term "salutogenesis" to describe how individuals are able to deal with negative and hostile forces in the environment in a vigorous manner that led to their enrichment instead of their diminishment.[48]

Antonovsky states that when we use a pathological orientation, the purpose is to explain why people get sick and enter a given state of disease or illness. When we take salutogenic orientation; however, we try to answer a very different question: why are people located toward the positive end of the health/disease continuum or why do they move towards the end at different points in space and time? Salutogenesis does not take the biomedical, reductionistic approach to health by focusing only on factors in a "person's social, economic, and emotional environment which generate or foster the growth of illness and disease," as seen in western medicine and academic research. Instead, salutogenesis takes a holistic, ecological understanding of health at the biological, individual, and community levels, focusing on features of the environment across physical, economic, natural, social, and spiritual dimensions "that foster health, nourish wellness."[49] MacDonald states that taking a salutogenic approach helps us to conceptualize health as a dynamic process by which we reap the benefits of the resources found in our environment. While, a pathogenic orientation is concerned with the origins of disease, a salutogenic orientation is concerned with the opposite: the origins of wellness, well-being, or health. Thus an environment deemed to be healthy also is classified as salutogenic.[50]

The goal of the ecological framework presented in this article mirrors the goal of the salutogenic framework posited by Antonovsky and MacDonald,[51] Putnam's *Bowling Alone: The Collapse and Revival of American Community*,[52] and other work on community assets mapping

[40]Galea and Vlahov, "Urban health"; Sandro Galea (ed.), *Macrosocial Determinants of Health*. (New York, NY: Springer, 2007); S. Galea, J. Ahern, A. Karpati, "A model of underlying socioeconomic variability in human communities: evidence from ecologic variability in population health and implications for public health," Social Science & Medicine 60 (2005): 2417–2430; Sandro Galea and David Vlahov, "URBAN HEALTH: evidence, challenges, and directions," *Annual Review of Public Health* 26 (April 2005): 341–365.

[41]Freudenberg, Galea, and Vlahov, "Beyond Urban Penalty and Urban Sprawl."

[42]David Vlahov and Sandro Galea, "Urbanization, urbanicity and health," *Journal of Urban Health* 79(4 Supp 1) (March 2002): S1–S12.

[43]Schulz and Northridge, "Social determinants of health."

[44]Gee and Payne-Sturges, "Environmental health disparities"; Payne Sturges and Gee, "National environmental health measures."

[45]Morello-Frosch and Lopez, "The riskscape and the color line"; Morello-Frosch et al., "Environmental justice and southern California"; Morello-Frosch and Jesdale, "Separate and unequal."

[46]Aaron Antonovsky, *Unravelling the Mystery of Health: How People Manage Stress and Stay Well. (*San Francisco, CA: Jossey-Bass, 1987).

[47]J.J. MacDonald, *Environments for Health: A Salutogenic Approach*. (Sterling, VA: Earthscan, 2005).

[48]Antonovsky, *Unravelling the Mystery of Health*; MacDonald, *Environments for Health*.

[49]Antonovsky, *Unravelling the Mystery of Health*; MacDonald, *Environments for Health*.

[50]MacDonald, *Environments for Health*.

[51]Antonovsky, *Unravelling the Mystery of Health*; MacDonald, *Environments for Health*.

[52]Robert D. Putnam, *Bowling Alone: The Collapse and Revival of American Community*. (New York: Simon & Schuster, 2000).

and social capital.[53] The salutogenic approach can facilitate the growth and maintenance of healthy communities through positive planning and community development for populations and individuals who "live, work, and play" in community ecosystems. The use of community planning, zoning, and development initiatives and environmental health policies that help foster salutogenic environments will have important implications for population health in unhealthy community ecosystems, particularly for vulnerable EJ populations who are differentially exposed to environmental and psychosocial stressors.

By focusing on the process of environmental salutogenesis within and across community ecosystems, we can increase resiliency in vulnerable communities particularly EJ communities. Resiliency acts as a resource and pathway for communities to respond to acute events and chronic stress, prevent negative public health outcomes, and improve community health, well-being, and quality of life. For example, global climate change will disparately impact the poor, people of color, indigenous populations, and the Global South reports the Environmental Justice and Climate Change Initiative (EJCC).[54] Sze and London write that "global climate change is a key issue in which environmental justice frameworks are particularly useful because the roots of the problem are found in the differential power and global inequalities in relationship with the environment."[55] The aftermath of Hurricanes Katrina and Rita in New Orleans in 2005,[56] the impact of Hurricane Floyd on Princeville, NC, in 1999,[57] and the 1995 Chicago Heat Wave[58] revealed how disadvantaged, vulnerable, and at-risk populations bear the brunt of climate-related perturbations. Community-based advocacy, religious, and social service organizations can operationalize the salutogenic framework on the ground to act as and create the salutogenic infrastructure necessary for community ecosystems to have the resiliency and social capital needed for preventive public health particularly in response to climate change and disasters.

The next section provides a more detailed discussion on important ecologic salutogens that enhance resiliency and ecologic pathogens that reduce resiliency.

SALUTOGENS AND PATHOGENS IN THE SOCIAL AND BUILT ENVIRONMENTS

When we take the ecological approach presented in Figure 1, we are able to track the quality and health of the structural components that constitute community ecosystems and designate these components as global indicators of health. These structural components include ecologic salutogens and pathogens. Salutogens are ecologic features of the built and social environments that restrict a population's vulnerability to adverse health outcomes. Salutogens buffer vulnerable populations from the adverse effects of negative environmental exposures and increase health, resiliency, well-being, quality of life, and social capital. There are many ecologic features of community ecosystems that can be classified as salutogens, including good housing quality, urban greenways and parks, medical facilities, schools, green space, supermarkets, grocery stores, recreational facilities, banks, sewer and water infrastructure, equitable and just transportation networks, community gardens, churches, and social service organizations. Acting as the structural components of community ecosystems that provide the foundation for the maintenance and advancement of community health, salutogens embody the strengths, assets, and resources that planners, public health agencies, municipal governments, and community members can build upon as the centerpieces of health promotion and prevention in community ecosystems.[59]

Ecologic pathogens are those features of the built and social environments that enhance a population's vulnerability in a community ecosystem. In addition, exposure to or presence of these ecologic factors can lead to or increase risks of adverse health outcomes for populations and individuals. Ecologic pathogens act as stressors in the community environment and limiting factors on the overall health, sustainability, vitality, and quality of life in community ecosystems. There are different types of pathogens, including social pathogens (i.e., poverty, structural racism, crime, violence, drug environs), built environment pathogens (e.g., poor housing stock, lack of medical infrastructure, limited sewer and water infrastructure, poor quality roads, pedestrian infrastructure), food environment pathogens (e.g., fast food restaurants, liquor stores, convenience stores), economic pathogens

[53]MacDonald, *Environments for Health*; Michelle C. Kegler et al., "Relationships Among Youth Assets and Neighborhood and Community Resources," *Health Education and Behavior* 32 (Jun 2005): 380–397; K. Fulbright-Anderson, A.C. Kubisch, and J.P. Connell. *New Approaches to Evaluating Community Initiatives*.(Queenstown, MD: Aspen Institute, 1998); J.P. Connell, *New approaches to evaluating community initiatives: concepts, methods, and contexts*. (New York: The Aspen Institute, 1995); Margot Breton, "Neighborhood resiliency," *Journal of Community Practice* 9(1) (June 2001): 21–36; Kenneth Temkin and William M. Rohe, "Social capital and neighborhood stability: an empirical investigation," *Housing Policy Debate* 9(1): 61–88; Robert D. Putnam, *Better Together: Restoring the American Community*. (New York: Simon & Schuster, 2003); James Macinko and Barbara Starfield, "The utility of social capital in research on health determinants," *Milbank Quarterly* 79(3) (Sept 2001):387–428.

[54]J. Andrew Hoerner and Nia Robinson, "Climate of Change."

[55]Julie Sze and Jonathan K. London, "Environmental justice and the crossroads," *Sociology Compass* 2/4 (2008): 1331–1354.

[56]SSRC, "Understanding Katrina"; Elliot and Pais, "Race, class, and Hurricane Katrina."

[57]Edna V. Gay, "Hurricane Floyd and the ensuing flood in North Carolina: a personal journal," *Journal of Emergency Nursing* 28(3) (June 2002): 216–222; S. Farquhar, N. Dobson, "Community and University Participation in Disaster-Relief Recovery: An Example from Eastern North Carolina," *Journal of Community Practice* 12(3/4) (April 2005): 203–217.

[58]Eric Klinenberg, "Denaturalizing disaster: A social autopsy of the 1995 Chicago heat wave," *Theory and Society* 28(2) (April 1999): 239–295; Eric Klinenberg, *Heat Wave: A Social Autopsy of Disaster in Chicago*. (Chicago, IL, The University of Chicago Press, 2002).

[59]Payne-Sturges and Gee, "National environmental health measures"; Gee and Payne-Sturges, "Environmental health disparities"; Antonovsky, *Unravelling the Mystery of Health*; MacDonald, *Environments for Health*.

(e.g., quick loan facilities, pawn shops, payday lenders), and environmental pathogens (e.g., landfills, incinerators, coal-fired electrical plants, hazardous waste sites, urban blight, locally unwanted land uses, heavily trafficked roads, Superfund sites, brownfields, industrial corridors).[60]

In this framework, the presence of salutogenic and pathogenic features in each community ecosystem indicates the degree of "health" or "unhealthiness." I assert that "health" and "disease" in human ecological systems is signified primarily by the quality of the built environment, salutogenic infrastructure and resources, and presence of ecologic pathogens. Assuming that the aggregate number of salutogenic and pathogenic features in each community ecosystem acts as a relative measure of health, we therefore can categorize community ecosystems with more pathogenic features (i.e., violence, crime, poverty, substandard housing, environmental hazards, unhealthy land uses) as less healthy than community ecosystems with fewer pathogenic features and a greater number of salutogenic features and living conditions. The pathogenic nature of built environment conditions within and across community ecosystems, particularly those ecosystems that are spatially aggregated may explain the persistent nature of environmentally-related health disparities across race, ethnicity, socioeconomic status, and gender in cities and metropolitan areas in different geographic regions in the country. This ecologic conceptualization allows us to focus our research efforts on disparities in exposure, resource access, health, well-being, and quality of life using a spatiotemporal, multi-level, population-based approach.

There are multiple ways in which we can measure salutogens and pathogens in community ecosystems. Geographic Information Systems (GIS) has emerged as an important tool in understanding spatial and temporal variation in human exposure to environmental and social determinants of health, neighborhood quality, and environmental justice. Maantay[61] and Jerrett[62] have used GIS to assess the spatial distribution of environmental pathogens (e.g., air pollution) in urban areas and related health outcomes (e.g., asthma). In addition, Mohai and Saha[63] have introduced new spatial methods to understand racial and socioeconomic disparities in exposure to environmental pathogens.

Another approach that can be used to operationalize the conceptual framework and measure and quantify salutogens and pathogens is the performance of an Environmental Block Assessment (EBA). The EBA, funded by the Mott Foundation, provides a complete picture of land uses and the quality of neighborhood assets including housing stock, commercial properties, schools, churches, industrial plants, and government facilities.[64] The EBA methodology could be used in other geographic settings to assess the health of community ecosystems. To operationalize the temporal component of the framework, the neighborhood life calendar approach can be used to collect event histories of community-level change over time.[65] This approach will allow communities to perform "ground-truthing" of community assets and pathogens across time which has been effective in other work.[66] Furthermore, the University of Michigan's Prevention Research Center (PRC) developed "The Speak to Your Health! Community Survey" to understand and monitor determinants of community health and well-being.[67] This survey has provided important data that is helping officials improve the health of Genesee County, Michigan residents.[68]

The integrated use of GIS, block assessment methods, neighborhood life calendars and community health surveys may be an effective way to: 1) operationalize the framework at the community level, 2) help community-based organizations quantify the spatial and temporal distribution of salutogens and pathogens, and 3) support evidence-based, prevention-focused policies that may improve community health, resiliency, and quality of life.

CONCLUSIONS

By taking a systems approach, we can modify features of the built and social environments, both salutogenic and pathogenic features which act as proximal determinants of health. For example, the modification of the built environment can increase connectivity between different neighborhoods, decrease social isolation, improve social cohesion, and lead to the production of more social and ecological capital. The new reserve of social and ecological capital can act as a salutogenic resource for populations to use in their efforts to overcome exposure to

[60]Payne-Sturges and Gee, "National environmental health measures"; Gee and Payne-Sturges, "Environmental health disparities"; Antonovsky, *Unravelling the Mystery of Health*; MacDonald, *Environments for Health*.

[61]Maantay, "Asthma and air pollution."

[62]Michael Jerrett et al., "Spatial analysis of air pollution and mortality in Los Angeles," *Epidemiology* 16(6) (Nov 2005): 727–736; Michael Jerrett et al., "A GIS-environmental justice analysis of particulate air pollution in Hamilton, Canada," *Environment and Planning* A 33(6) (2001): 955–973.

[63]Paul Mohai, Robin Saha, "Reassessing racial and socioeconomic disparities in environmental justice research," *Demography* 43 (May 2006): 383–399.

[64]University of Michigan-Flint (UMF). 21st Century Environmental Block Assessment. Available at <http://www.flinteba.org>. Accessed July 1, 2006.

[65]William G. Axinn, Lisa D. Pearce, and Dirgha Ghimire, "The neighborhood history calendar: a data collection method designed for dynamic multilevel modeling," *Sociological Methodology* 27 (1997): 355–92; William G. Axinn, Lisa D. Pearce, and Dirgha Ghimire, "Innovations in life history calendar applications," *Social Science Research* 28(3) (September 1999): 243–264.

[66]Wilson et al., "Community-driven environmental protection"; Wilson et al., "Built environment issues"; Wilson et al., "Use of EPA collaborative problem-solving model"; Heaney et al., "The West End Revitalization Association."

[67]University of Michigan Prevention Research Center (PRC). PRC Speak to Your Health! Survey. Available at: <http://www.sph.umich.edu/prc/projects/speak/index.html>. Accessed on August 20, 2008.

[68]University of Michigan Prevention Research Center (PRC). PRC Speak to Your Health! Survey. Available at: <http://www.sph.umich.edu/prc/projects/speak/index.html>. Accessed on August 20, 2008.

negative living conditions and increase resiliency and adaptation in response to declines in the social, economic, and environmental health of their ecosystems.[69]

The systems approach to examining community health and environmental health disparities requires that we develop different health indicators and a systems-oriented environmental tracking program. Instead of just tracking the prevalence, incidence, and mortality related to obesity, asthma, cardiovascular disease, and cancer, we should develop alternative health indicators that take into account the physical condition of urban environments and focus on the salutogenic and pathogenic features of our communities. This approach may provide substantive information that can be used to develop better health policies and planning and development policies that focus on the overall quality of communities particularly urban locations and regions where vulnerable EJ populations "live, work, and play."

The application of this ecological framework in the field of community health may help researchers, planners, practitioners, and community members build healthier communities. Municipal governments from small town councils to regional metropolitan governments will have an important role to play in the implementation of this ecological framework to build, maintain, and modify environmental conditions in order to distribute resources more equitably and reduce the disparate burden of environmental pathogens on vulnerable, underserved, and disadvantaged populations. Thus, a shift to a health promotion and prevention approach in designing neighborhoods, towns, and cities may lead to the construction and maintenance of living environments that are both healthy and sustainable. Furthermore, new movements and organizations focused on labor rights, human rights, sustainability, climate justice, smart growth, conservation, indigenous rights, food justice, water rights, energy justice, and ecofeminism may benefit from using this ecological framework. In the future, we should explore the use of the ecological framework to support emerging and innovative environmental health disparities research—the next wave of research to advance environmental justice science, and grassroots research, leadership, and activism for social justice, social change, and community health improvements.

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[69]Kegler et al., "Relationships Among Youth Assets"; Fulbright-Anderson, Kubisch, and Connell. *New Approaches to Evaluating Community Initiatives*; Connell, *New approaches to evaluating community initiatives*; Breton, "Neighborhood resiliency"; Temkin and Rohe, "Social capital and neighborhood stability"; Putnam, "*Bowling Alone*"; Putnam, *Better Together*; Macinko and Starfield, "The utility of social capital"; "Ecological resilience—in theory and application," *Annual Review of Ecology and Systematics* 31 (Nov 2000): 425–439; Jan Rotmans, Marjolein van Asselt, and Pier Vellinga, "An integrated planning tool for sustainable cities," *Environmental Impact Assessment Review* 20 (June 2000): 265–276; C. Monfreda, M. Wackernagel, and D. Deumling, "Establishing national natural capital accounts based on detailed Ecological Footprint and biological capacity assessments," *Land Use Policy* 21(3) (July 2004): 231–246; William Rees and Mathis Wackernagel, "Urban ecological footprints: Why cities cannot be sustainable—And why they are a key to sustainability," *Environmental Impact Assessment Review* 16(4–6) (July–Nov 1996): 223–248.

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