

Environmental Change, Risky Sexual Behavior, and the HIV/AIDS Pandemic:

Exploring Linkages Through Livelihoods in Rural Haiti

Lori M. Hunter

Department of Sociology
Institute of Behavioral Science, CU Population Center
Population, Environment and Society Programs
University of Colorado at Boulder

John Reid-Hresko

Department of Sociology
University of Colorado at Boulder

Tom Dickinson

Institute of Behavioral Science, Computing and Research Services
Department of Geography
University of Colorado at Boulder

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Abstract: Natural resources are central to rural livelihoods across much of the developing world. As such, resource availability greatly shapes livelihood options and resource scarcity may drive households to seek alternative livelihood strategies. We examine the association between natural resource scarcity, change, and the potential to engage in risky sexual behaviors. We do so with an eye toward contributing to recent scholarship examining transactional sex as a means of acquiring necessary goods (e.g., Bene and Merten 2009 on fish-for-sex trade in Kenya). We further do so to examine the potential for environmental scarcity and change to contribute to perpetuation of the HIV/AIDS pandemic since such behaviors have been associated with disease vulnerability. Research examining the association between HIV/AIDS impacts and the natural environment has been hampered by a shortage of HIV/AIDS data at the individual and household level. We make use of Demographic and Health Survey data from Haiti combined with vegetation measures generated from satellite imagery. In all, our work contributes in two ways to understanding of the ways in which environmental change may contribute to population dynamics: 1) its focus on Haiti, a setting outside sub-Saharan Africa although also impacted by HIV/AIDS and 2) its focus on livelihood decline as a potential driver of HIV/AIDS vulnerability through risky sexual behaviors.

Recent demographic scholarship has become more attuned to the ways in which environmental context shapes demographic behaviors. Consider, for example, land scarcity and tenure constraints as factors shaping the recent Kenyan fertility decline (Shreffler and DoDoo 2009). Of particular policy import, substantial recent concern has arisen regarding climate change's potential to increase in migration rates, particularly within highly impacted regions (e.g., Warner et al. 2009). Such insight into population-environment associations suggests that our

understanding of the factors shaping core demographic processes may simply be incomplete (or worse, incorrect) without consideration of environmental factors.

Such incomplete understanding is especially likely when examining social patterns and processes within settings characterized by high levels of dependence on proximate natural resources. Indeed, especially in rural regions of the world's less developed nations, environmental change has immediate and direct impacts on the health and well-being of millions of households since natural resources are often essential in meeting basic living requirements (Koziell and Saunders 2001). Important land-based activities include arable farming, livestock husbandry, and consumption and trade in natural resources (e.g., fuelwood, wild herbs). Given this high level of resource dependence, changes in the availability of local natural resources hold tremendous potential to impact livelihoods and, in turn, demographic processes such as migration and mortality.

Of demographic concern within the present research is the HIV/AIDS – a dramatic force shaping the demographic dynamics of many of the world's less economically developed regions. Today, an estimated 33 million individuals are living with HIV, and recent data suggest that, every day, over 6800 persons become HIV-infected and over 5700 persons die from AIDS (UNAIDS 2006).

On the AIDS-environment link, prior research has, for example, linked natural resources to food security within AIDS-impacted households (e.g. Hunter, Twine and Patterson 2008; Kaschula 2008), as well as land tenure regimes to AIDS-impacted livelihood strategies (Frank and Unruh 2008). Still, research examining the association between HIV/AIDS impacts and the natural environment has been hampered by a shortage of HIV/AIDS data at the individual and

household level. These data are difficult to obtain for a variety of reasons including the stigma that remains associated with the disease, the difficulties inherent in collecting biological samples, and lack of knowledge of infection among some HIV+ individuals. The research presented here represents an innovative efforts to draw upon secondary data sources to explore the potential environmental dimensions of HIV/AIDS.

In this paper, we examine the environmental context of risky sexual behaviors – an important shaping force within the HIV/AIDS pandemic. Although an underexplored linkage, we argue it is a logical one since in natural resource-dependent regions, proximate resource degradation lessens viable livelihood options – and recent scholarship has documented transactional or “survival” sex as an alternative livelihood strategy (e.g., Bene and Merten 2009). Indeed, in some cultural settings, such sex-based trade is viewed as normative and not simply about survival, but rather about achieving a particular standard of living, commensurate with the perceived commodities of modernity (Leclerc-Madlala 2004).

Our particular concern is the potential for the “environmental scarcity-risky sex linkage” to operate in areas of high HIV prevalence. Risky sexual behavior in these regions is clearly linked to increased susceptibility to HIV/AIDS. As such, such risky sexual behaviors may pose serious risk at the individual level while also further fueling the pandemic in the aggregate – suggesting that environmental scarcity may exacerbate the pandemic by fueling such risky behavior.

Making use of Demographic and Health Survey data from Haiti combined with satellite imagery reflecting shifts in vegetation availability across time, we examine associations between proximate environmental change and risky sexual behavior. We also consider

knowledge of HIV/AIDS and prevention strategies in order to better understand motivations for risky behavior. Haiti is a particularly important setting for this study given its relatively high HIV prevalence and since the vast majority of existing scholarship on the pandemic has been situated in sub-Saharan Africa. In all, our work contributes in two ways 1) its focus on Haiti, a setting outside sub-Saharan Africa although also impacted by HIV/AIDS and 2) its focus on livelihood decline as a potential driver of HIV/AIDS vulnerability through risky sexual behaviors.

In the remainder of this paper, we provide a general overview of the HIV/AIDS pandemic in Haiti, followed by a short review of existing literature on HIV/AIDS' impacts on rural livelihoods. We then outline the theoretical framework employed and present our hypotheses. A review of the Haiti Demographic and Health Survey and remotely sensed data is then offered, followed by results and concluding discussion.

Background

As noted in the introduction, the HIV/AIDS pandemic is negatively affecting rural livelihoods in developing settings in a variety of ways, including undermining food security and subsistence strategies (e.g., Kaschula 2008, Murphy 2008, Hunter et al. 2007). In addition, the pandemic continues to undermine and erode social networks and social capital (Pronyk et al. 2008, Gaede et al. 2006).

HIV/AIDS and Risky Sexual Behavior in Haiti: Haiti is the most heavily HIV/AIDS-affected nation in Latin America and the Caribbean. An estimated 85% of seropositive individuals in the Caribbean reside on the island divided between the Dominican Republic and Haiti (Putnam et al. 2002). As such, Haiti is among the most HIV/AIDS-affected nations in the world outside

of Sub-Saharan Africa and, therefore, an appropriate research setting for the project presented here.

In Haiti, HIV is spread primarily through heterosexual intercourse and mother-to-child transmission (Deschamps et al 1996). Factors which have facilitated the emergence of the Haiti HIV/AIDS pandemic include poverty, sociopolitical instability, stigmatization, social norms which promote multiple concurrent partners, limited access to health care and health care facilities, and poor governmental response (Hempstone et al. 2004). These influential conditions validate claims that HIV/AIDS represents more than a biological condition; rather it is rooted in socioeconomic and political conditions (Hunter 2007, Barnett and Whiteside 2002, Farmer 1999, 1992). Indeed, Farmer has written extensively about the HIV/AIDS epidemic in Haiti and concludes that poverty and inequality, both of which are tied to larger political economic conditions, have greatly accelerated the spread and devastation of HIV/AIDS in Haiti and are constitutive of the patterns of structural violence that accompany HIV/AIDS across the globe (1999).

As a prime example of both the structural violence under which HIV/AIDS spreads and the relationship between declining rural livelihoods and HIV/AIDS, Farmer (1992) recounts a tale of rural Haitians forced from their agricultural land due to hydroelectric dam development. The Haitians moved to safer ground, but were unable to continue their agriculturally-based livelihoods due to the lack of arable land in the resettlement area. This population, now lacking the sustainable rural livelihood which had supported their families for generations, became highly susceptible to HIV, which proceeded to decimate the settlers.

There are also important gender dimensions to the Haitian pandemic. Gender inequality, oppressive poverty, economic dependency, and low levels of education have all been linked to greater female susceptibility to HIV in Haiti (Smith Fawzi et al. 2005, Farmer 1999, 1992). Haitian women are largely disempowered within the arena of sexual decision-making and have little negotiating power concerning condom use or other safe sexual behaviors (Hempstone et al. 2004). Elsewhere, the connections between gender-based economic disparities have also been linked to increased risk of HIV (Dunkle et al. 2004), as have poverty and low educational attainment (Tladi 2006), external socioeconomic conditions and forces (Hunter 2007), and hunger and malnutrition (Oyefara 2006).

While commercial sex work is legal in Haiti, we focus on risky sexual behavior and not commercial sex work because transactional sex arrangements and survival sex do not always fall under the rubric of commercial sex. As noted, in many social settings, transactional sex is viewed as normative and not simply about survival, but rather about achieving a particular standard of living, commensurate with the perceived commodities of modernity (Leclerc-Madlala 2004). The term 'prostitution,' thoroughly implicated in western conceptualizations of sexuality and exchange, is not necessarily an appropriate lens through which to view sexual relations in non-western settings (Hunter 2002). Additionally, Leclerc-Madlala (2004) contends that not all women who engage in transactional sex self-identify as engaging in commercial sex, particularly when this survival strategy is coupled with other means of generating income or is used to achieve a particular level of consumption. Overall, since this research is not intended to enter the prostitution/commercial sex worker debate, we choose to use proxies for risky sexual behavior as our dependent variables, rather than transactional or commercial sexual behavior.

HIV/AIDS and Rural Livelihoods: That HIV/AIDS is affecting the viability of rural livelihoods has been widely established in academic literature (Hunter et al. 2008, Kaschula 2008, Murphy 2008, Edstrom and Samuels 2007, Masanjala 2007, de Waal and Tumushabe 2003, Loevinsohn and Gillespie 2003, Barnett and Whiteside 2002, Mitka 2001, 2000). Loevinsohn and Gillespie (2003) contend that HIV is endogenous to livelihood and agricultural systems – the such systems shape both the susceptibility to HIV and its consequences.

Specific to natural resources, the proximate natural environment plays an important role in rural livelihoods by providing for household needs as well as offering income-generating opportunities (Shackleton and Shackleton 2000; Shackleton et al. 2001; Letsela et al. 2002; Twine et al. 2003a). When environmental conditions deteriorate – particularly when combined with HIV/AIDS impacts -- it is women, children, and the elderly that pay the highest price (Hunter et al. 2007, de Waal and Tumushabe 2003). These impacts are diverse and include a loss in household labor quality and quantity and a general reduction in available disposable liquid income and assets bases (de Waal and Tumushabe 2003). Other noted impacts consist of increased dependency ratios and the loss of experiential-based knowledge as prime age adults succumb to AIDS (Edstrom and Samuels 2007). In addition, land uses shift and sometimes land access is lost due to inheritance customs (Frank and Unruh 2008).

Negative impacts on food security have been particularly noted as a negative livelihood consequence of HIV/AIDS. Kaschula (2008) details the particular manners in which HIV/AIDS-affected households experience greater food insecurity and how they utilize greater dietary diversity as a coping mechanism. Furthermore, noticeable alterations in farming, crop, and gardening techniques have been tied to the epidemic's myriad impacts (Murphy 2008). Hunter

et al. (2007) note important substitution effects, wherein rural households rely on their environmental surroundings more heavily once affected by HIV/AIDS, while Loevinsohn and Gillespie further assert that the HIV/AIDS pandemic affects the extent of resource depletion in rural environments (2003). While widely perceived as a form of coping, we might more productively address this increased natural resource and environmental reliance as a struggling strategy (Rugelema 2000).

Additionally, Mitka (2001, 2000) and Tumushabe (2004) detail community level impacts, contending that rural livelihoods are embedded in networks of social reciprocity and that as HIV affects rural communities, these social bonds, which had previously provided another resilience coping mechanism for suffering households, are compromised, fracturing social and cultural ties.

This body of literature works off the fundamental premise that HIV/AIDS affects and threatens rural livelihoods, undermines household assets and resource bases, thereby increasing the likelihood of future livelihood collapse, resulting in a vicious poverty/HIV/AIDS cycle and has been considered the conventional poverty-AIDS nexus (Masanjala 2007, Loewenson and Whiteside 2001). Other scholars have recently argued for a “New Variant Famine,” a dramatic position that argues that the effects of HIV/AIDS upon rural communities and livelihoods have been so severe that there is, likely, no hope of a rebound or mitigation of the effects of HIV/AIDS on such communities and that we are witnessing the emergence of a new, permanently disenfranchised group, the AIDS-poor (de Waal and Whiteside 2003). While this may seem drastic, the effects of HIV/AIDS upon the rural poor and food security in Haiti are so significant that it bears consideration.

A notable feature of this body of literature is its directionality -- it focuses almost exclusively on how HIV/AIDS undermines rural livelihoods while increasing vulnerability. Yet a reciprocal relationship is also possible in that a lessening of rural livelihood strategies may predispose certain individuals and households to engage in risky sexual behavior resulting in greater susceptibility to HIV. Thus our work contributes in two ways 1) its focus on Haiti, a setting outside sub-Saharan Africa although also impacted by HIV/AIDS and 2) its focus on livelihood decline as a potential driver of HIV/AIDS vulnerability through risky sexual behaviors.

To conceptually situate our research, we use a theoretical framework drawing on the livelihoods approach described by Masanjala (2007) and couple it with Barnett and Whiteside's (2002) social definition of susceptibility.

Livelihoods Framework and Susceptibility

“Poverty and inequality can drive those on the margin of destitution into risky livelihood and coping strategies that raise their likelihood of contracting HIV.” (Masanjala 2007:1032)

As suggested by this quotation, it is crucial to acknowledge that HIV/AIDS is cannot be simply described as a disease of the poor. It is also rooted in political, socioeconomic, and cultural contexts (Hunter 2007, Barnett and Whiteside 2002, Farmer 1999, 1992). Since our focus is on the manners in which declining rural livelihoods and resource scarcity may predispose women to engage in risky sexual behavior, this insight underpins the theoretical foundations we employ.

Masanjala (2007) invokes the HIV/AIDS and livelihood body of literature discussed above to assert that HIV/AIDS impacts various aspects of rural livelihoods in unsustainable ways. The argument centers around four related elements: 1) livelihood assets (including human, financial, physical, and social capital), 2) the vulnerability context (the degree of risk of livelihood collapse due to economic, political, and/or environmental factors external to the household), 3) livelihood strategies, and 4) transforming structures and processes (i.e., socioeconomic and political developments which may negatively impact sustenance provision).

Still, Masanjala is quick to note the limitations of the livelihoods approach, noting that it assumes the homogeneity of households and erases gendered inequality within the household. Such inequality predisposes women to bear the majority of the HIV/AIDS inflicted burden. For this reason, he couples the livelihoods framework with a social relations approach that foregrounds gendered dimensions of interaction and livelihood strategies. This is particularly germane to our research since we focus on women and their potential use engagement in risky sexual behavior as a livelihood coping/survival strategy.

This framework is useful for Haiti as rural Haitians possess few livelihood assets. Those they do possess are increasingly affected by HIV/AIDS prevalence. Additionally, as the aftermath of Hurricane Gustav recently demonstrated, the vulnerability context of rural Haitian is extreme.

While Masanjala borrows the above notion of vulnerability from Barnett and Whiteside (2002), we also find it necessary to utilize their distinctive social notion of susceptibility in our theoretical framework. They contend that scholars must look not only at the downstream effects of HIV/AIDS, which is what the previously discussed impacts of HIV/AIDS upon rural

livelihoods addresses, but that we must also look at upstream determinants of HIV infection risk. Thus, we contend that much literature has addressed such downstream effects and attempt, in this article, to use changes in land use and coverage as a proxy to examine potential upstream determinants of HIV exposure and infection.

Their notion of susceptibility addresses the likelihood of HIV/AIDS exposure and infection vis-à-vis risky environments and situations in which one is located and the riskiness of the behaviors one chooses or is forced to engage in and has been utilized by a number of scholars since its introduction (Masanjala 2007, Morton 2006, Weigers et al. 2006, Loevinsohn and Gillespie 2003). Like Masanjala, we contend that unsustainable, declining, or insufficient rural livelihoods constitute a upstream powerful force, which may result in the adoption of risky sexual behavior to compensate.

Thus, we acknowledge that rural livelihoods are both effected by, and affect, the HIV/AIDS pandemic in important, gendered ways for communities, households, and individuals. We believe that in much the same way this has been well demonstrated within the Sub-Saharan context, we can productively explore this relationship between HIV/AIDS and rural livelihoods in Haiti by coupling Masanjala's livelihoods and social relations framework with Barnett and Whiteside's conceptualization of susceptibility. In the following sections, the methodological approach used in this study will be presented, followed by presentation of results and an ensuing discussion.

Research Setting, Data & Methods

Haiti is the poorest country in the western hemisphere and ranked 153 out of 177 nations in the UNDP Human Development Index in 2004, with more than 50% of the population living on \$1 a day and more than 75% of the population living below the poverty threshold of \$2 a day (World Food Program 2008).

Agriculture remains the mainstay of the Haitian people's livelihoods, with 67% of the population relying on agriculture for their income and more than 60% of the population classified as rural. Furthermore, food insecurity in Haiti is severe, with daily food insecurity affecting 40% of Haitian households and a food supply that only covers only 55% of the population (ibid).

The 2000 Demographic and Health survey used for the analyses to follow is a standardized survey addressing a wide breadth of standard sociodemographic information and health topics including, for the purposes of this article, knowledge regarding HIV, where that knowledge comes from, how HIV can be avoided, sexual history, attitudes towards sexually transmitted diseases, individual STI history, and a women's module addressing women's autonomy, decision making, freedom of movement, asset possession and control, and access to money. The survey was administered to 10,159 fecund women, ages 15-49, in 9,595 households.¹

Our dependent variables represent risky sexual behavior and are measured in several ways: 1) used a condom during last sex and 2) number of partners, other than husband/partner, in last 12 months.

¹ A more recent DHS survey from Haiti has been made available. Yet, since the most recent available satellite imagery for Haiti is from 2000, we chose to use the earlier DHS data.

Our measure of diminishing natural resources available for rural livelihood opportunities is calculated from satellite imagery. The images reflect 1990 and 2000 vegetation coverage and were obtained from the Landsat GeoCover dataset at the Global Land Cover Facility. Preprocessing consisted of two major steps - geometric registration and radiometric and atmospheric normalization (Song et al. 2001). The Landsat Geocover dataset obtained was already orthorectified thereby satisfying geometric registration. For radiometric and atmospheric normalization, the Dark Object Subtraction method was used (Song et al. 2001; 233-234), implemented in ENVI software. "DOS3" was used to compensate for Rayleigh scattering (Song et al. 2001).

With the radiometrically corrected images at the ca. 1990 and ca. 2000 timesteps, a Normalized Difference Vegetation Index (NDVI) was calculated and masks created to eliminate sea/cloud pixels. The images were then imported into ArcMap 9.1 where differences between timesteps were calculated. In addition, the NDVI data were analyzed around the study "cluster" points.

In the end, we incorporate measures of NDVI reflecting the following within a 5-kilometer (2.31 mile) buffer surrounding each DHS respondent: 1) mean NDVI, 2000, 2) change mean NDVI, 1990-2000, and 3) percentage change mean NDVI, 1990-2000.

In addition to resource change as a key predictor measure, we also centrally integrate a poverty measure given its centrality to livelihoods, risky sexual behavior as well as HIV/AIDS vulnerability. "Assets" is included as a measure of socio-economic status. This is an additive measure reflecting the sum of specific household possessions which, within this setting, are suggested to reflect household economic well-being. Considered possessions include:

household electrification and ownership of a radio, television, bicycle, refrigerator, car/truck and/or motorcycle/scooter.

Of course, given the acknowledgement that natural resource availability is often intimately tied to household well-being, it is logical to assume correlation will exist between measures of SES and proximate resource availability. Indeed, our measure of assets is correlated at -0.20 ($p < 0.00$) with mean NDVI within a 5-km buffer. Further, the percentage change in NDVI, 1990-2000, is also significantly correlated with SES, with greater percentage change associated with lower asset scores (-0.04, $p < 0.01$). Correlation also exists between the various environmental measures. As would be anticipated, higher levels of proximate vegetation at baseline (1990) is associated with greater change across the period 1990-2000 (0.63, $p < 0.00$) as well as greater percentage change (0.69, $p < 0.00$). Our multivariate models will further explore, and control for, these important spatial correlations.

Further, risky sexual behavior may be influenced by many factors other than reduced natural resource-based livelihood strategies. As such, we control for a variety of characteristics shown by prior scholarship to shape sexual behavior. First, knowledge of HIV/AIDS is important and we consider the association between risky sexual behavior and if respondent 1) has ever heard of AIDS, 2) is aware of ways to avoid AIDS, and 3) believes always using condoms during sex reduces chances of AIDS. We, of course, incorporate consideration of age, education, income, and empowerment given their associations with risky sexual behavior.

In all, we hypothesize that women in areas of greatest vegetation loss, and those most intensely experiencing poverty, will be relatively more likely to engage in risky sexual behavior net of the impacts of, age, education, income, HIV knowledge and empowerment. This

expectation is rooted in the diminished livelihood options resultant of natural resource decline and poverty.

Results

Descriptive statistics first offer a sense of the distribution of our key variables within the DHS sample. We then present bivariate associations between our central variables of interest followed by multivariate models.

On the dependent variables specifically, while most respondents (~67%) were aware that condoms are a preventive measure against HIV, less than 3% reported condom use during their last intercourse. This low rate of condom use has been linked to religious beliefs, high levels of illiteracy, the economic value tied to children in agricultural-based settings, and the “plurality and looseness of unions.” (Maynard-Tucker 1996:1379-1380). Although the majority of respondents (~81%) noted no extra-union partners within the past year, approximately 16% did.

Socio-economic status and vegetation change represent central predictor variables. On SES, the descriptive table clearly reveals the impoverishment felt by rural Haitians. Although the index ranges from 0 to 7, the mean value is just 0.64 suggesting that, on average, rural households have less than one of the assets incorporated (household electrification and ownership of a radio, television, bicycle, refrigerator, car/truck and/or motorcycle/scooter).

(Table 1 about here)

Dramatic variation in vegetation changes is also apparent. The mean NDVI varies from a minimum of 0.23 to a maximum of 0.83. The trend of deforestation is also clear in estimations of mean change NDVI, 1990-2000, of 0.09 with a minimum of -0.23 and a maximum of only 0.1. Substantial variation also exists with regard to percentage change – with an average 13.51% vegetation loss during the decade, although some gain was also experienced (maximum 17.88%).

On “control” variables, Table 1 presents a picture of HIV/AIDS in Haiti wherein nearly everyone is aware of HIV/AIDS, yet this does not translate into modified behavior or accurate knowledge perceptions.² Specifically, although 97% of respondents were aware of the existence of HIV/AIDS, 32% responded they were unaware of any means of prevention while an additional 17% responded “don’t know” to the question of AIDS avoidance. Further, more than half of the respondents indicated either that HIV/AIDS could be transmitted by supernatural means and sorcery or did not know that this means of transmission was not possible (data not shown). Considered from a cultural perspective, this is understandable since Haiti is characterized by multiple belief systems, some of which focus on what we term the occult or voodoo, are in play concerning health and health care. On other “control” variables, our sample is, on average, 30 years of age with only 3 years of education. Two-thirds are married and half are Catholic.

² We agree with Murphy et al. (2005) and Masanjala (2007) that the household is a problematic analytical unit, due to its methodologically imposed heterogeneity, and should be reconceptualized to bear more resemblance to the fluidity of actually existing social relations. Still, there remains no better existing demographic data source than DHS at present.

Bivariate Associations. To offer preliminary examination of the association between risky sexual behaviors, natural resource change and poverty, Table 2 presents bivariate relationships.

(Table 2 about here)

Results reveal some statistical significance within the associations between AIDS knowledge, sexual behaviors, SES and environmental context. Specifically, women of lower SES expressed less awareness of ways to avoid AIDS ($p < 0.00$), with those expressing such knowledge averaging 0.91 on the asset scale relative to 0.44 for those lacking such knowledge. Logically, given the correlation between SES and proximate resources, we also identify statistically significant bivariate associations between proximate resource level and change (1990-2000).

As for awareness of condoms as a means of reducing AIDS transmission, women of low SES were more likely to respond “don’t know” suggesting lesser awareness of means of protection. Few other patterns are apparent with regard to this knowledge.

On specific behaviors, results suggest that women of lower SES were significantly less likely to make use of a condom during their last sexual encounter ($p < 0.00$). Specifically, mean value on the asset scale being 0.62 for those not using condom during last sexual encounter, as contrasted with 1.67 for those that did use a condom. As related to proximate resources, women from regions characterized by resource scarcity were less likely to *know* if a condom had been used during their last sexual encounter ($p < 0.028$) suggesting perhaps a link between scarcity and vulnerability.

As to number of partners, women of higher SES tended to have greater number of partners ($p < 0.027$) while those in areas with lower vegetation exhibited the same behavior ($p > 0.011$). No bivariate associations are apparent between vegetation change measures and this indicator of risky sexual behavior.

Multivariate Spatial Models: Forthcoming.

Discussion & Conclusion

In this article, we build on and synthesize several bodies of literature involving HIV/AIDS knowledge, sexual behaviors as well as natural resources and rural livelihoods. We add to the emerging literature on the environmental dimensions of HIV/AIDS, particularly as related to the pandemic's spread in rural regions of the developing world characterized by high levels of resource dependence and environmental change. Explicitly, we model the association between HIV/AIDS knowledge, awareness, and sexual behaviors among fecund women in Haiti, with a focus on the predictive ability of measures of proximate resource availability and change.

Haiti was selected as an appropriate site for this project, as it is among the countries with the highest adult seropositivity levels outside of sub-Saharan Africa (2.2%) and allows us to apply the insights regarding HIV/AIDS effected human/environment interactions emerging from Sub-Saharan Africa in a different geographic context (UNAIDS 2008). Additionally, there is an established body of literature interrogating HIV/AIDS in Haitian contexts (Smith Fawzi et al. 2005, Farmer 1999, 1997, 1995, 1992, Deschamps et al. 1996). On a practical level, as well, the existing Demographic and Health Survey for Haiti explored questions related to AIDS

awareness, condom use and sexual behaviors – in addition to sufficient geographic identification of respondents -- allowing for examination of this population-environment association without collection of additional data.

That said, the focus of this paper is on the ways that changing rural livelihood opportunities may predispose women to engage in risky sexual behavior, building on the idea of survival sex (Muir 1991). Following Farmer (1992), Haitian, low-income, rural women are particularly vulnerable to HIV infection due to the manner in which the socioeconomic and political aspects of the pandemic are fundamentally rooted in poverty, as well as economic and gender inequality.

In all, our work contributes in two ways 1) its focus on Haiti, a setting outside sub-Saharan Africa although also impacted by HIV/AIDS and 2) its focus on livelihood decline as a potential driver of HIV/AIDS vulnerability through risky sexual behaviors. We find ...

Given the dramatic impacts of HIV/AIDS particularly in many regions of the world characterized by high levels of natural resource dependence, explicit consideration of the environment dimensions of HIV/AIDS is of great relevance. It is our hope that, combined with the substantive results presented here, this inquiry spurs additional consideration of this association within, and across, the research, policy, and practitioner communities in order to facilitate improvements in both social and environmental well-being in rural regions hard-hit by the HIV/AIDS pandemic.

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Table 1: Descriptive Profiles of Variables Reflecting Risky Sexual Behavior, SES and Natural Resource Scarcity, Haiti Demographic and Health Survey, Rural Respondents 2000

Dependent Variables	Yes	No	Don't Know	N
Used a condom during last sex?	2.61%	97.14%	0.25%	4173
# partners, other than husband, in last 12 months				5937
0	80.77%			
1	15.55%			
2+	0.46%			
Primary Predictor Variables	Mean	Min	Max	
Assets	0.64	0	7	5938
Within 5k buffer, NDVI=vegetation coverage				
Mean NDVI, 2000	0.56	0.23	0.83	5938
Change Mean NDVI, 1990-2000	-0.09	-0.23	0.1	5938
Percentage Change Mean NDVI, 1990-2000	-13.51	-40.01	17.88	5938
Control Variables				
Ever heard of AIDS?	96.98%	3.02%		2945
Aware of ways to avoid AIDS?	50.84%	32.20%	16.96%	2867
Believe always using condoms during sex reduces chances of AIDS?	67.74%	15.45%	16.80%	1454
Age (in years)	29.58	15	49	5938
Education (in years)	2.98	0	7	3478
With partner (married or cohabiting)	67.93%			5938
Catholic	50.95%			5938

*Sampling w eights used

Table 2: Bivariate Associations between Risky Sexual Behavior, SES and Natural Resource Scarcity, Haiti Demographic and Health Survey, Rural Respondents 2000

	Mean	Sig	N		Mean	Sig	N
Aware of ways to avoid AIDS?				Used a condom during last sex?			
SES		p<0.000	2866	by SES			
yes	0.91			yes	1.67	p<0.000	4172
no	0.44			no	0.62		
DK	0.51			DK	0.00		
by NDVI, 2000				by NDVI, 2000			
yes	0.59	p<0.030	2866	yes	0.59	p<0.028	4172
no	0.60			no	0.59		
DK	0.58			DK	0.51		
by change NDVI, 1990-2000				by change NDVI, 1990-2000			
yes	-0.06	p<0.000	2866	yes	-0.06	p<0.116	4172
no	-0.07			no	-0.07		
DK	-0.07			DK	-0.15		
by % change NDVI, 1990-2000				by % change NDVI, 1990-2000			
yes	0.59	p<0.407	1453	yes	-9.26	p<0.188	4172
no	0.06			no	-10.12		
DK	0.59			DK	-23.66		
Believe always using condoms during sex reduces changes of AIDS?				Number of partners, other than husband, in last 12 months			
by SES		p<0.001	1453	by SES			
yes	0.95			0	0.67	p<0.027	5936
no	0.97			1	0.76		
DK	0.61			2+	0.93		
by NDVI, 2000				by NDVI, 2000			
yes	0.59	p<0.041	1453	0	0.59	p<0.011	5936
no	0.58			1	0.58		
DK	0.59			2	0.56		
by change NDVI, 1990-2000		p<0.233	1453	by change NDVI, 1990-2000			
yes	-0.06			0	-0.06	p<0.172	5936
no	-0.07			1	-0.07		
DK	-0.06			2	-0.07		
by % change NDVI, 1990-2000				by % change NDVI, 1990-2000			
yes	-8.83	p<0.305	1453	0	-9.61	p<0.157	5936
no	-10.25			1	-10.38		
DK	-8.92			2	-10.81		