Chapter 14

AIDS and Watersheds: Understanding and Assessing Biostructural Interventions

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Introduction

Over the past 15 years, evidence has accumulated of how HIV/AIDS impacts rural people who depend for their food and livelihood on agriculture and the management of natural resources. Evidence is also available, though less extensive, of how changes in the rural environment influence the dynamics of HIV/AIDS. It is striking, however, how little this understanding has yet to contribute to the methods used in the struggle with HIV/AIDS. The "expanded response" that UNAIDS is spearheading to meet the targets set by the UN General Assembly Session on HIV/AIDS in 2001 includes no reference to agricultural or natural resource–based measures for prevention, treatment, and care (Stover et al. 2002). This is hardly surprising because there is as yet little documented evidence of their effectiveness in HIV/AIDS control terms or feasibility on a wide scale. Much less is it clear how such efforts might be financed. Across the sectoral divide, agricultural and natural resource management policies and programs are aimed at enhancing food security, improving nutrition, and expanding livelihood opportunities. However, the decisionmakers responsible for the most part have a very limited understanding of how these may be affecting HIV/AIDS risks, positively or negatively, and how these inadvertent effects can be optimized. Few have a clear understanding of how HIV/AIDS is affecting or will in the future affect attainment of the objectives they now pursue and what adjustments will be necessary to keep these in sight.

The base of evidence and experience is gradually deepening as some of the presentations at this conference demonstrate; however, the profile of this body of work remains very low. A new term, biostructural intervention, may help to clarify the nature and potential of what is at stake. In public health, a structural intervention is one that addresses the determinants of health problems situated in the social, political, or economic environments. With respect to HIV/AIDS, structural interventions have most frequently been considered in relation to factors that impede or facilitate an individual's efforts to avoid HIV infection (Parker, Easton, and Klein 2000; Sumartojo et al. 2000) but can also address treatment and care of PLWHA and mitigation of AIDS' impacts. A biostructural intervention (BSI) can be defined as a structural intervention that draws on efforts to enhance the benefits people derive from living natural resources such as through agriculture, fishing, or forestry and that seeks to ensure that a part of these benefits supports public health objectives, in the present context those of HIV/AIDS control.

The contribution that BSIs can make is growing as HIV epidemics are becoming increasingly rural in character in Sub-Saharan Africa and other regions (NAC 2003; PFI/PRB 2003). They offer a number of potential advantages in comparison to individually focused medical and public health interventions or structural interventions that do not draw on renewable natural resources but can also complement them. They also present certain difficulties and challenges. The balance needs to be assessed in each situation, drawing on the best information available, making decisions, and refining them in the light of improved understanding: applying what Loevinsohn and Gillespie (2003) term an "HIV/AIDS lens."

An example can help clarify the kinds of advantages and drawbacks a BSI may offer. In Lesotho, CARE and the Ministry of Agriculture are in the early stages of a program to support households and schools in taking up intensive homestead gardening and water harvesting (Abbot et al. 2005). Focusing on households affected by AIDS and providing home-based care to people living with HIV/AIDS, the initiative promotes local foods that enhance nutrition and bolster immune function. If these households indeed manage to take up and adapt the approaches to their particular conditions, sustainable improvements in nutrition and increased longevity for those living with HIV/AIDS are possible, at a cost probably lower than achievable through nutrition supplements. The fit to local and individual conditions can be hastened to the extent that households draw on their agricultural knowledge, experiment, and exchange their experiences, features less readily available to other interventions. Local institutions, formal and informal, can support such experimentation and exchange and also mobilize collective action to enable the weakest to benefit. Importantly, a successful homestead garden increases the resources available to affected households which they can use for other purposes—related or not to HIV/AIDS. Again, such flexibility is generally not a feature of other interventions.

On the other hand, a program such as home garden promotion can take longer to roll out and to get food into people's mouths than one based on supplements. People under considerable stress and with little time are less likely to be able to experiment (Loevinsohn, Meijerink, and Salasya 2001). Local institutions may themselves be under great strain in high-prevalence situations such as Lesotho, and their ability to support the weakest may be undermined. Power relations and divisions within communities can further marginalize the weakest, as can the stigma attaching to AIDS, though this may be less an issue where prevalence is high and no family is untouched.

A supplement program in support of home-based care can be implemented by a health ministry, possibly in collaboration with health-oriented NGOs. A program that includes home gardens needs the support of the ministry of agriculture and of NGOs with agricultural skills, inevitably increasing the difficulties of coordination. The agricultural organizations will also need to acquire new skills and perspectives. They will need to work with some of the poorest of households, often headed by women, to foster their participation and facilitate experimentation. These skills prove to be among the most difficult for large organizations to acquire and to practice effectively, particularly as pilot programs are taken to scale. The erosion of experience within organizations as a result of AIDS makes the challenge all the greater.

Finally, the agricultural organizations need to ensure that they maintain a reasonable balance within and among their various objectives. HIV/AIDS is not the only impoverishing force affecting rural areas, and a proper concern with equity requires that people also be addressed who are poor as a result of causes other than HIV/AIDS and who may be differently situated. This will be particularly important where the prevalence of HIV and AIDS is still low but increasing. It will also be important for the organizations to ascertain to what extent responding to the needs of people at risk of HIV and AIDS entails compromise with objectives such as supporting agricultural productivity and environmental integrity. These issues are likely to play out differently in different contexts.

This chapter examines these issues in greater depth in relation to one potential BSI, watershed development (WSD) in India. WSD is an evolving approach that seeks to conserve and harmonize the use of soil, water, pasture, and forest resources while increasing agricultural productivity within an area, typically of a few hundred to several thousand hectares, that is drained by a common outlet. Over the past several decades, increasing attention has been paid to ensuring local participation and to concerns such as employment creation and equity for women, the landless, and other vulnerable groups. More than US$500 million is invested annually in WSD programs across the country by the central and state governments and donors (Singh 1994; Turton 2000; Kerr 2002).

The assessment focuses on two main questions:

- What is the contribution, potential and actual, of WSD and related efforts to HIV/AIDS control?

- How might taking on HIV/AIDS control support or undermine achievement of the objectives that WSD programs are currently pursuing?

The analysis is intended to be strategic and to provoke reflection by the stakeholders of both WSD and similar programs and of HIV/AIDS control. It makes use of an epidemiologic model and recent data on the epidemiologic context of HIV in South India and on the social impact of WSD to create and compare realistic scenarios, buttressed by qualitative analysis. Scenario modeling adds to the HIV/AIDS lens concept a new degree of both rigor and flexibility. WSD is highlighted because it is an approach widely practiced in South Asia and other regions and because there is a substantial literature available on its social impacts. However, the same analysis could, in principle, be carried out on other approaches that have sought to buttress food and livelihood security, indeed whether or not explicitly linked with improved natural resource management. The primary focus is on the contribution of food and livelihood security to HIV prevention, a dimension that has been relatively neglected by research (Loevinsohn and Gillespie 2003) and one that is of critical importance in India where prevalence nationally is still low, less than 1 percent, but increasing and now reaching significant levels in some areas, especially in the four large southern states of Maharashtra, Andhra Pradesh, Karnataka, and Tamil Nadu (UNAIDS 2004). However, it is no less relevant to Africa, where prevalence is higher and many of the same situations of risk can be identified.

Watershed Development and Its Social Impacts

A variety of WSD programs have been designed over the past several decades by states and the central government, some with the assistance of foreign donors. The approaches have differed, depending on conditions in the regions targeted and the orientation of the leading organizations. All have been concerned with improving water availability to people, crops, and livestock and with conserving soils. The preoccupation in the early years with production and productivity and the emphasis on implementation of physical structures have, with time, been balanced by social objectives: relieving distress in areas of chronic water scarcity and soil degradation and achieving greater equity among farmers cultivating different parts of the watershed, the landless, and those dependent on pasture and forest resources, often women and *adivasis* (Hanumantha Rao 2000; Shah 2001a,b; Kerr 2002).

The visual impact of WSD is often striking. Within a few seasons, once dry, bare hillsides are covered in grass, shrubs, and young trees; wells that ran dry not long after the rains now provide drinking water all or most of the year, and fields whose crops withered when the rains faltered now yield one and often two harvests a year under irrigation. Among the first steps in WSD typically is to restrict access to pastures and forests in the upper parts of the watershed to permit the vegetation to recover and water to infiltrate and recharge wells and reservoirs. Those who benefit first and in greatest measure are generally farmers with fields in the lower reaches. People who depend on the fodder and forest products from the upper parts—women, the landless, and *adivasis*—will be hurt by the restrictions. These groups typically are also not well represented in village councils. Some of the pioneering WSD projects such as Sukhomajri and the *Pani Panchayats* and efforts elsewhere, particularly NGO-led, have sought innovative ways to avoid this structural inequality. These have included granting water rights to the landless, which they can trade to farmers or use on rented land, and expanding employment opportunities based on natural resources. Fostering the emergence of institutions that can give voice to the interests of these groups has also been key. These ideas have spread and influenced practice widely, but equity and broad-based participation remain major challenges in WSD programs (Fernandez 1994; Shah 2001a,b; Kerr 2002; Fernandez 2003).

For some rural households, particularly those relatively well placed in terms of land and connections in urban areas, seasonal migration can be part of a deliberate strategy to diversify livelihoods. However, for many of the rural poor, seasonal migration is a key dimension of distress. Reliable estimates of its prevalence are available for only a few rural areas; for example, 65 percent of households in 42 villages in Madhya Pradesh, Gujarat, and Rajasthan (Mosse et al. 2002) and 35 percent of households in one village in West Bengal (Rafique and Rogaly 2003) had at least one member involved in migration. Similar or higher levels have been reported elsewhere (Srivastava, Sasikumar, and Giri 2003; Washington et al. 2004a). Men, married or single, typically form the bulk of migrants, though in some cases women in significant numbers and even whole families are involved. Distress migration often has significant social and environmental costs in the source areas, for example, reducing the labor available for land improvement and increasing the burden on family members who remain behind. In the destination areas, migrants often face low wages and poor housing and sanitation. Women are exposed to sexual abuse

(Shah 2001b; Mosse et al. 2002; Srivavstava, Sasikumar, and Giri 2003). Migrants are typically found to have higher rates of HIV (Decosas et al. 1995) or to engage more frequently in risky sexual behavior than nonmigrants, as recent work in Rajasthan has shown (Washington et al. 2004a).

The extent to which seasonal migration, or at least its most pernicious and dangerous forms, has been curtailed is one of the social criteria that is often used to assess WSD's impact. In some of the early projects such as Sukhomajri, complete elimination is claimed, at least in years of reasonable rainfall.[1] One of the few wide-scale assessments is from Andhra Pradesh, where, in some 2,000 watersheds in a year of below-average rainfall (1988–89), migration was found to have been reduced by 10 to 40 percent (Hanumantha Rao 2000). Several observers are skeptical about the extent to which these benefits are shared by the landless and marginal farmers. Significant increases in employment, beyond the initial construction phase, have, in general, proven more difficult to achieve than has improved water availability and extended irrigation in the lower reaches of watersheds (Shah 2001a,b; Joy and Paranjape 2004). In his survey of watersheds in Andhra Pradesh and Maharashtra, Kerr (2002) found that as many as one-third of the landless claimed that they had been harmed by WSD in some of the large government programs. Whether this additional distress translates into a net increase in migration from the watershed is not clear. Projects implemented by NGOs or by NGOs and government jointly were more likely to have been judged beneficial by the landless.

The Epidemiologic Context

With more than 1 percent of their adult populations estimated to be infected with HIV, the four southern states of Maharashtra, Andhra Pradesh, Karnataka, and Tamil Nadu are deemed to harbor generalized HIV epidemics. A striking feature of these epidemics is that prevalence in rural areas, as measured at antenatal surveillance sites, is similar to or higher than that in urban areas (PFI/PRB 2003; Washington et al. 2004b).[2] In Africa, infection rates are typically substantially higher in urban areas (UNAIDS 2004). Among attendees at STD clinics in Karnataka, HIV prevalence in those working in the agricultural sector was more than 70 percent above the median (18.6 percent vs. 10.8 percent) and greater than that in people working in the transport sector (15.9 percent), a high-risk group in many parts of the world. Migrant workers were found to be particularly affected (Washington et al. 2004b).

Some of the highest HIV rates are found in Karnataka's northern districts. In one of these, Bagalkot, the India-Canada Collaborative HIV/AIDS Project (ICCHAP) has carried out population-level surveys and more focused studies of sex workers and their clients, providing one of the few detailed pictures of HIV/AIDS epidemics outside India's large urban centers. Across the district, prevalence is estimated at 2.9 percent; in the rural areas it is half again as high as in the urban areas (3.6 percent vs. 2.4 percent). Among agricultural workers, HIV infection (6.2 percent) was more than twice the district mean. Prevalence among adult men was a third higher than that among women (3.3 percent vs. 2.5 percent). However, among those 15–19 years of age, prevalence was more than five times greater among women than men (3.2 percent vs. 0.6 percent), likely reflecting marked inequalities of power and a substantial level of cross-generational sexual relations. Knowledge of HIV/AIDS, its causes, and prevention measures is generally poor, especially in rural areas. Only 6 percent of rural women claim to have ever seen a condom (KSAPS et al. 2004; Blanchard, Reza-Paul, and Ramesh 2004).

Poverty, indebtedness, abandonment, and widowhood were the most common reasons women cited for entering commercial sex work. Many women in northern Karnataka enter through the *devadasi* or temple dancer tradition. They are typically younger and have more clients than other sex workers, are more likely to be illiterate, rural-based, and less able to influence the conditions under which sex is exchanged. Sex work is conducted in a variety of locations in urban and rural areas: at home, in lodges or brothels, at roadsides, or in other public places. In the urban areas of Bagalkot district, female sex workers were estimated to represent 1.1 percent of the 89,000 women aged 15–49, and their clients 20.4 percent of the 93,000 men (Foss et al. 2004; KSAPS et al. 2004; Blanchard et al. 2005).

The scenario modeling that follows considers the links between food and livelihood insecurity and two situations of risk: seasonal migration and commercial sex work. Others, which may be of epidemiologic significance but for which there is limited research to draw on in this context and are not modeled, include transactional sex of an occasional, possibly seasonal nature, early marriage, and the sexual vulnerability of women left behind when men migrate. I return to these issues in the Discussion.

Methods

In the context of HIV/AIDS, epidemiologic models have frequently been used to assess an intervention's contribution to prevention in a specific locale, both among the individuals targeted and among those to whom they would have otherwise transmitted the infection (i.e., secondary prevention) (Grassly et al. 2001). Such models have also been used to estimate the effectiveness of a suite of individual prevention measures in halting the spread of HIV/AIDS at national, regional, and global levels (Stover et al. 2002). The AIDS Strategic Intervention Simulation Tool

(ASIST), a mathematical model and user interface (Ferguson et al. 2002), has been used in both applications. Here ASIST is used in a strategic sense to assess the contribution of a structural intervention, WSD, in different scenarios based on the context of northern Karnataka.

The model underlying ASIST is formulated as a set of ordinary differential equations. These describe a population of adults divided according to HIV status: either susceptible or in any of five stages of infection, from incubation to full-blown AIDS. The population is further stratified by sex, sexual activity class, and whether individuals are covered by control interventions. Heterosexual partnerships and mother-to-child transmission are the only infection routes considered by ASIST. The sexual activity classes, defined for the population being modeled, are characterized by the rate of partner change and the number of sex acts per partnership per year. Sexual mixing is represented by means of an "assortativity" factor, where 1 implies that people choose their partners at random among the activity classes and 0 that they choose them only from within the same activity class. When a partnership occurs across activity classes, the number of sex acts is determined by the highest-activity individual. Adolescents are recruited to the population as susceptible adults, and individuals die at a rate determined by life expectancy and HIV/AIDS status.

A viral and a bacterial sexually transmitted infection are modeled in parallel with HIV, and prior infection with either increases the likelihood of HIV transmission. Five control interventions can be modeled by ASIST. Skills-based education reduces the rate of partner change and thus infection risk for both HIV and the other STIs. Correct use of condoms likewise increases protection against all three infections, and treatment of the bacterial STI reduces HIV risk at the same time. On the other hand, antiretroviral therapy is specific to HIV, slowing progression from one infection stage to another and reducing viral shedding. ASIST can also be used to explore the impact of a hypothetical microbicide whose efficacy and rate of uptake can be varied. Ferguson et al. (2002) provide a more detailed description of the model.

The baseline scenario draws on the epidemiologic and demographic characteristics of Bagalkot district. It envisages the adult population of such a district divided into three interacting sexual activity classes: a high-activity class, which includes both rural and urban sex workers and their clients; and an urban and a rural class, both with lower levels of sexual activity. Sex workers are assumed to have 460 different partners per year, the mean in northern Karnataka (KSAPS et al. 2004), and their clients nine new partners per year, near the lower end of the range calculated by Foss, Vickerman, and Watts (2004). The rural men who join this activity class are migrants (though not all migrants are necessarily in this class). Men in the rural class are assumed to have one-third as many new partners as migrants, as Washington et al. (2004a) found in rural Rajasthan, that is, three new partners per year. Men in the low-activity urban class are assumed to have two new partners per year, in line with the lower prevalence in urban areas. Women in both urban and rural low-activity classes are assumed to have a new partner only once in 20 years, based on data from Bhattacharjee et al. (2004) that suggest that most of the relationships women in Bagalkot have outside of marriage occur before marriage. Sex workers and their clients are assumed to have two sex acts per partnership in a year, and men and women in the low-activity rural and urban classes 52 acts per year, in line with survey results in Bagalkot (Foss, Vickerman, and Watts 2004).

The urban population is assumed to consist of 186,000 adults 15–49 years of age, of whom 20,045 (19,000 men, 1,045 women) are in the high sexual activity class (Foss et al. 2004).[3] The rural adult population is assumed to be 455,400, based on the 29 percent/71 percent urban/rural distribution of Bagalkot's population (Census of India 2001). In the baseline scenario, 25 percent of the rural population are assumed to migrate, a relatively modest rate in comparison to the situations referred to in the previous section, and join the high-sexual-activity class. Women are assumed to be 5 percent of these high-activity migrants, as in the urban areas.

ASIST is designed to assess specific individually oriented interventions and imposes several limitations when adapted to assess structural ones such as WSD. Scenarios in which, for example, migration levels are altered can be simulated only as different runs of the model, assuming that the intervention had been in place at the beginning of the epidemic. In contrast, condom distribution and the other predefined interventions can be introduced at any point. ASIST also offers only limited capacity to model different patterns of interaction among the sexual activity classes by means of the assortativity factor described earlier. The baseline scenario uses 0.8 for this factor, reflecting a situation in which migrants return relatively frequently, such as seasonally, to their rural homes (Washington et al. 2004a), and urban high-activity men and women often maintain concurrent relationships with their spouses or partners.

Other model parameters are given in Table 14.1.

Results

Figure 14.1 illustrates the effect on HIV prevalence in the urban and rural population of WSD in place from the beginning of the epidemic, which consistently reduces migration by 40 percent, the top end of the range among Andhra Pradesh watersheds cited by Hanumantha Rao (2000). WSD targeted at the areas managed by 200,000 adults (44 percent of the rural population) reduces the peak prevalence

Table 14.1 Simulation parameters other than those described in the text

Demography:	
Fertility rate (per woman, per year)	0.1332
Natural death rate (in the absence of AIDS)	0.0154 (equivalent to life expectancy 65 years)
Child aging rate (1/age at sexual debut)	0.0666
Simulation settings:	
Steps per sample	1
Tolerance	10^{-6}
Epidemiology:	
Year HIV epidemic started	1985 (First Indian AIDS case reported 1986)
Bacterial STDs:	
Transmission rate M→F/F→M	0.5 / 0.25
Recovery rate (per year) symptomatic/asymptomatic	12 / 12
Proportion males symptomatic/asymptomatic	0.9 / 0.1
Proportion females symptomatic/asymptomatic	0.4 / 0.6
Viral STDs:	
Transmission rate M→F/ F→M	0.07 / 0.01
Enhancement of viral STD transmission caused by HIV infection, by HIV stage I–IV	1 / 1 / 4 / 12
HIV:	
Transmission rate M→F/ F→M	0.0005 / 0.00025
Relative infectiousness by stage	3 / 1 / 2 / 4
Progression rates of each incubation stage	4 / 0.114 / 1 / 2
Vertical transmission, by incubation stage	0.25 / 0.25 / 0.25 / 0.25
Cofactor enhancement of HIV infectiousness: Symptomatic bacterial STD/asymptomatic bacterial STD/viral STD	2 / 2 / 2
Cofactor enhancement of HIV susceptibility: Symptomatic bacterial STD/asymptomatic bacterial STD/viral STD	4 / 4 / 3

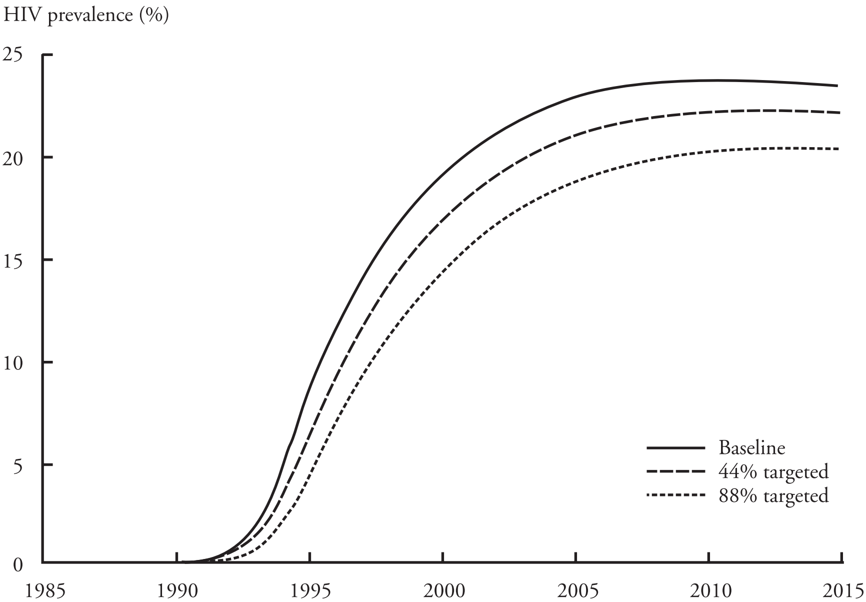
Note: These are the ASIST default values unless otherwise noted (Ferguson et al. 2002).

by 6.3 percent; targeted at the areas managed by 400,000 adults (88 percent of the rural population), it reduces peak prevalence by 14 percent. However, prevention of infection is a better measure of impact, and these efforts are more effective in these terms, particularly in the early stages of the epidemic: over the first 15 years (1985–2000), the 200,000-person effort averts 12.8 percent of infections, the 400,000-person effort 27.3 percent.

A modest economy of scale is evident: the 200,000-person effort averts 6 percent more infections over the first 15 years than would be expected from a linear extrapolation of an effort targeting 10,000 people. The scale effect for the 400,000-person effort is 12.7 percent.

This scenario envisages a fairly free mixing of the urban and rural population, particularly of high-sexual-activity individuals, as might occur in an area with good roads and transport. A contrasting scenario is of a relatively isolated rural popula-

Figure 14.1 Effect of watershed development on the prevalence of HIV at two levels of effort in targeting the rural population



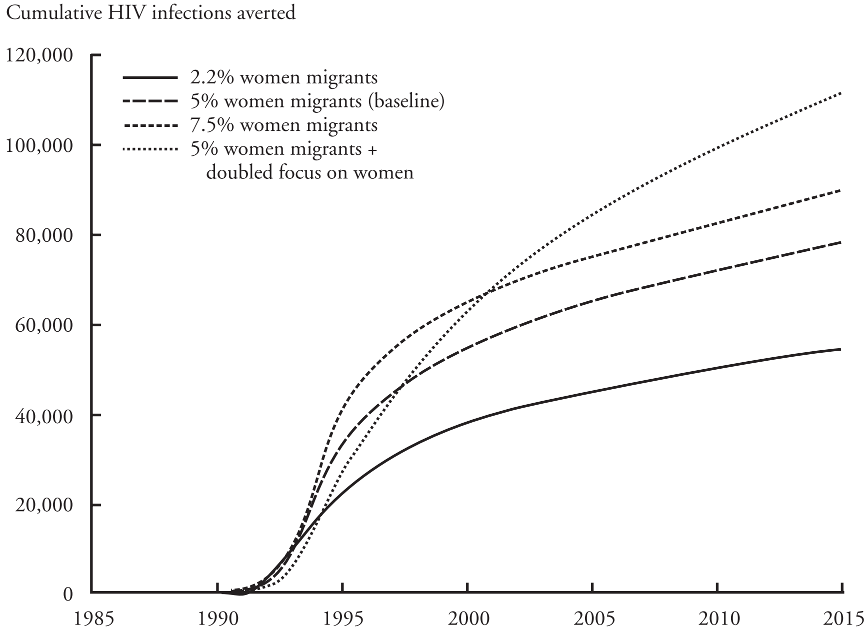
Note: The population consists of 455,000 rural and 186,000 urban adults linked by high-sexual-activity migrants. WSD is assumed to reduce migration by 40 percent.

tion that has its "own" group of high-activity men and women, as might occur around a rural industry or plantation. The number of infections averted by a given level of WSD effort is quite similar in this "isolated" and the "integrated" baseline scenario. However, in the integrated case, urban people share in the benefits: with 400,000 rural adults targeted by WSD, 14.4 percent of the infections prevented in the first 15 years are in the low-sexual-activity urban class. I return to this issue below.

The baseline scenario assumes that high-sexual-activity women constitute 5 percent of rural migrants and that WSD reduces migration to the same extent for both men and women. Figure 14.2 illustrates the sensitivity of results to changes in these assumptions, when the initial level of migration (25 percent of the rural population) and WSD's impact on migration overall (40 percent reduction) are held constant.

Over the first 15 years of the epidemic, WSD targeted to 88 percent of the population averts 31.4 percent fewer infections than in the baseline scenario when

Figure 14.2 Infections averted by watershed development



Note: Infections averted by watershed development, assuming different proportions of high-sexual-activity women among migrants and different proportions of the benefits of the program accruing to women. WSD is targeted at 400,000 adults (88 percent of the rural population) and reduces migration by 40 percent.

women constitute 2.2 percent of migrants and 17.6 percent more than the baseline when they constitute 7.5 percent of migrants. This highlights the importance of understanding women's involvement in distress migration in particular situations. The difference between the 2.2 percent and 7.5 percent cases involves 2,100 women, just 0.7 percent of the adult female population, but the difference in infections averted over 15 years is 27,400.

The effect of targeting the benefits of WSD more to women, doubling the proportion of women among those who are able to remain in the low-risk rural class, is ambiguous. Fewer infections are averted in the earlier years, but many more after about 12 years. This appears to be because men, who are the majority of migrants in these scenarios, play a key role as "bridges" between the high-activity class where HIV prevalence is greatest and the initially low-prevalence rural areas.

The impacts of WSD on HIV prevention considered so far have been inadvertent and unintended side effects. How might WSD complement formal HIV/AIDS control programs? Here I consider some epidemiologic aspects, returning in the next section to institutional ones.

Under the conditions of the baseline scenario, a condom promotion program that is in place at the beginning of the epidemic and that results in sex workers using condoms with 50 percent of their clients, similar to levels found in Karnataka (KSAPS et al. 2004), is able to maintain prevalence at relatively low levels, at least for the first 20 or so years (Fig. 14.3). A delay of five years in implementing the program, however, allows HIV to reach higher prevalence sooner. The consequences of the delayed public health response are mitigated to an extent if the rural area has benefited from WSD.

This can be seen more clearly from the infections averted (Fig. 14.4). Over the first 20 years of the epidemic, the five-year delay in implementing condom promotion results in more than 100,300 extra infections. The cost of delay is almost

Figure 14.3 Effect on HIV prevalence of watershed development and condom promotion, delayed or not by five years after the beginning of the epidemic

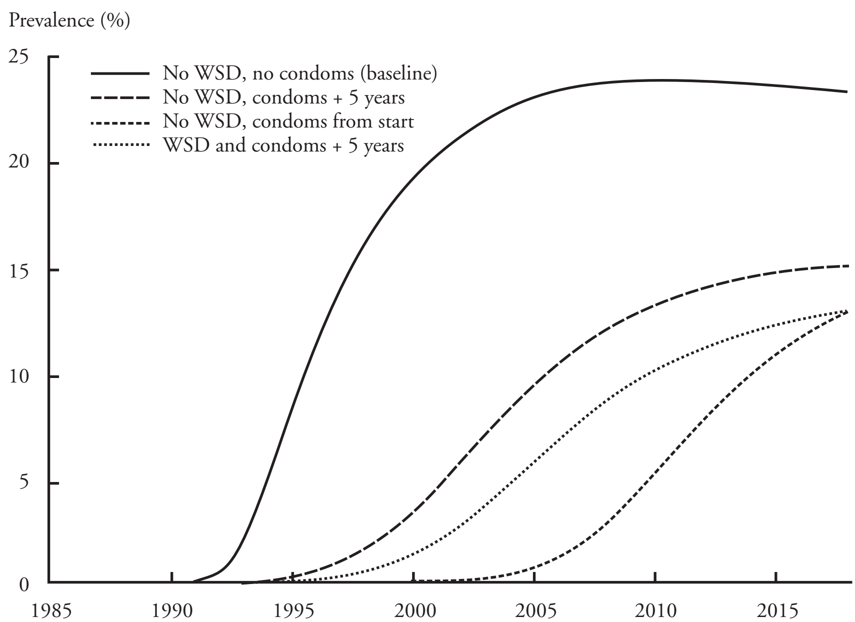
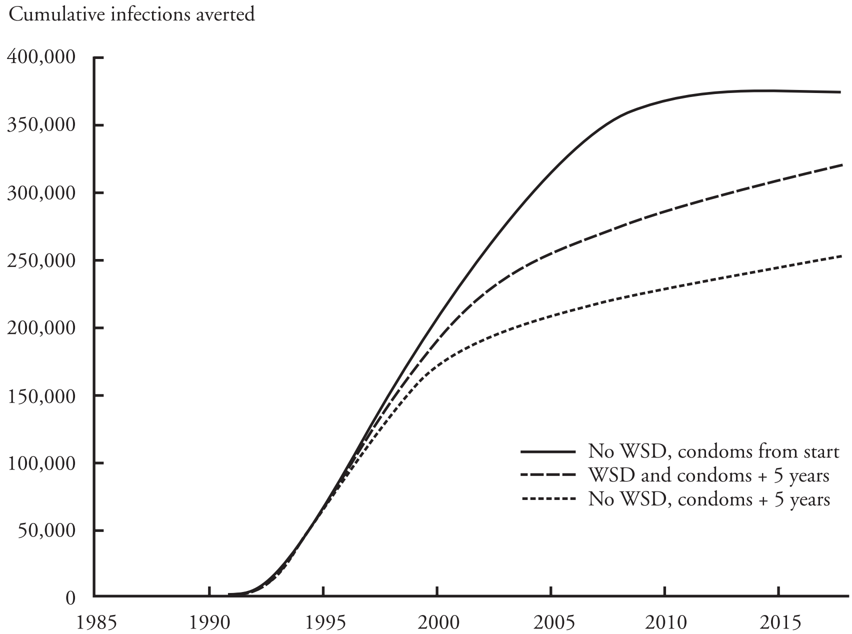


Figure 14.4 Infections averted by watershed development and condom promotion, delayed or not by five years after the beginning of the epidemic



halved (54,600 extra infections) if the delay occurs in an area where WSD has been in place from the start.

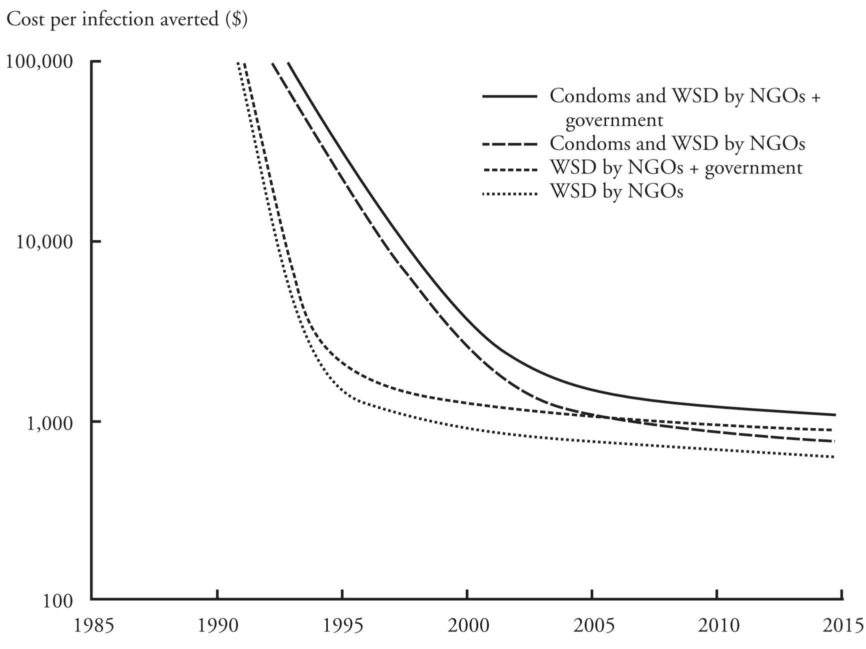
There is a synergistic interaction between WSD and condom promotion: the proportion of infections averted when both are implemented together is greater than would be expected from their individual effects. In the above case, the effect amounts to 23,300 infections over 20 years. This appears to result from their complementary modes of action: condoms reduce the risk from unsafe sex; WSD reduces the number of people at risk.

Although the objective was not to reproduce the Bagalkot situation, the scenario of WSD with condom promotion delayed by five years provides a reasonable approximation to the district's current pattern of infection: overall prevalence below 5 percent in 2003 and around 50 percent among sex workers.

The cost effectiveness of WSD in averting infection, with or without condom promotion, is illustrated in Figure 14.5. As in the above scenario, condom promotion is delayed by five years after the start of the epidemic. The analysis draws on cost estimates from Maharashtra (John Kerr pers. comm.) of Rs.2,686/person where NGOs implement WSD and Rs.3,753/person where NGOs and government agencies jointly implement the program (US$62/person and US$87/person, respectively, in 1999). The costs illustrated for situations where WSD and condom distribution are both present are for the portion of infections averted by WSD.

In the absence of condom promotion, WSD implemented by NGOs or by NGOs and government jointly would avert infections at a cost of $1,000 per infection after 13 and 23 years, respectively. In the presence of condom promotion, it would take 21 and 36 years for the NGO or NGO and government programs to reach the $1,000 per infection level. For comparison, condom distribution among high-risk women in Kenya averted HIV infections at a cost of $1,060 per infection (Creese et al. 2002). And Stover et al. (2002) estimate the cost-effectiveness of the expanded global prevention program, which draws only on individually focused interventions, at $1,000 per infection averted, and likely more, in the 2001–10 period.

Figure 14.5 Cost-effectiveness of watershed development in the presence or absence of condom promotion delayed by five years after the start of the epidemic



Discussion

These results suggest that some watershed development programs may currently be making a significant but entirely inadvertent contribution to the prevention of HIV/AIDS, in some situations at a cost comparable to single-purpose preventive measures. They may also be helping to mitigate the effects of delay in implementing those measures. The scenarios explored in this chapter are based on what is, in the Indian context, a high-prevalence area and assumes a level of effectiveness in reducing migration at the top end of what is likely achieved in most large-scale WSD programs. It assumes as well that this impact is sustained for a considerable period. There is little evidence available concerning the longevity of WSD efforts, save for pioneering "success stories" such as Sukhomajri and the *Pani Panchayats* in Maharashtra, which continue to operate successfully after more than 25 years (Kerr 2002). The scenario developed here therefore approaches a "best case."

As pointed out earlier, WSD has often failed to achieve broad-based participation in decisionmaking and equitable sharing of the fruits of environmental improvement. Water harvesting and soil conservation have benefited the landed and especially those with fields in the lower reaches of the watershed. Sustained increases in employment after the construction phase and improvements in the resources, often from common land, on which women, landless, *adivasis,* and other groups depend have been meager or nil in many areas. More of the landless say they have been harmed than helped in some large WSD programs by the restrictions on harvesting fodder and forest products (Shah 2001a,b; Kerr 2002). Where distress has actually increased among those most at risk of being pushed into situations of heightened HIV risk, and disparities of wealth have grown, WSD may be contributing to the spread of HIV. This is the "worst case" scenario.

Work on the ground is urgently needed to clarify these predictions. It should be possible to add assessment of changes in risky behavior to current or planned evaluations of WSD and related programs at relatively little cost. Greater clarity is needed on the impact of distress. Discussion in India usually revolves around migration and its hazards, whereas in southern and eastern Africa the emphasis is on transactional or "survival" sex, often involving more limited movement and possibly larger proportions of the rural population (Loevinsohn and Gillespie 2003; Bryceson, Fonseca, and Kadzandira 2004). To what extent is that more diffuse situation of risk present as well in specific Indian situations, and how is it affected by improvements in livelihood as a result of WSD and other efforts? Similarly, distress is often an important consideration when families contract early marriages for their daughters. Young women married to older men are at heightened risk of contracting HIV and STIs because their spouses are more likely to be infected than men their own age. Socially isolated and with limited autonomy and access to information, they have little ability to negotiate when and under what conditions sex occurs (Bruce and Clark 2004). Is there evidence that this situation of risk too has been reduced where livelihoods have become more secure? Clearer understanding of the HIV risks faced by different kinds of migrants, for example, those who move either more or less voluntarily, is also needed. Finally, more flexible model frameworks are required that can be used to assess the consequences of various patterns of migration and of interaction between and within rural and urban populations.

Beyond the unintended effects considered so far and the epidemiologic synergies suggested in the last section, how can WSD support HIV/AIDS control efforts in a more active sense? I believe the most important opportunities lie in the institutions that WSD has fostered at different levels. There is growing recognition of the importance of participatory groups, based on an affinity of interests, at the smallest scale that give voice to the concerns of those often not heard—women, landless, *adivasis*—in associations or councils at the watershed and wider scales (Fernandez 2003). These affinity-based groups can also provide health workers a means to reach people whose knowledge of HIV/AIDS and how to avoid it is often slight, though they may be among the most at risk. These groups provide their members a valuable forum for discussion.

The prospect of another form of synergy, between AIDS education and natural resource management, opens when people better understand the risks they face and when they see that there are means close to hand, such as WSD, that can help them avoid them. In much of eastern and southern Africa the opposite has been the case: many people with good knowledge of the health hazard are, for economic and other reasons, unable to act on it (Ngwira, Bota, and Loevinsohn 2002; Campbell 2003). Knowledge of the risks and of the means to avoid them is crucial but not sufficient when, as in a watershed, access to resources depends on the decisions of others.

How does responding to HIV/AIDS support or undermine achievement of the objectives that WSD programs are currently pursuing? Increasingly, equity is seen as *the* critical issue by government agencies as well as NGOs (Hanumantha Rao 2000; Kerr 2002). Failure to ensure equitable sharing of benefits threatens the participation that underpins the local adaptation of WSD, its productivity and sustainability (Fernandez 2003). There would seem therefore to be a shared interest in equity. Yet equity remains the hardest of objectives to achieve, particularly in large-scale programs. HIV/AIDS may help shift the balance. The scenarios explored in this chapter suggest that failure to achieve equitable sharing of benefits now has further consequences, infection risks, that are shared by all within the watershed and beyond, in the larger epidemiologic basin defined by people's movement and relationships. The challenge for those working with decisionmakers within and beyond the watershed will be to make these links clear and present in situations where many still do not have personal experience of AIDS. Handled clumsily, the attempt could backfire, particularly where AIDS-stigma is widespread and may attach to groups already marginalized.

In India, something of a tradition has evolved of learning from the experience of small-scale, pioneering efforts and intensive NGO-led projects in areas such as WSD and Joint Forest Management. The process has certainly not always been smooth or as rapid as some may have wished, but—through mechanisms including advocacy by the NGOs and their civil society partners; policy reviews; training of government and NGO cadres, sometimes together; and seconding of experienced NGO staff to government departments and programs jointly implemented by government and NGOs—there has been a general ratcheting up of practice and the emergence of more supportive policy. This experience and these mechanisms may well prove critical to the development of WSD and related programs as bio-structural interventions that consciously seek the synergies between human health and sustained, equitable management of natural resources.

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Notes

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1. Some NGOs, such as Social Centre in Maharashtra, aim not at stopping migration but at reducing its pernicious aspects and enabling the poor to benefit from its income-diversifying potential.

2. Across all four of the southern states, HIV infection at STD clinics was 7–27 percent greater among rural than urban attendees (PFI/PRB 2003).

3. The small adjustments from the breakdown cited earlier are necessitated by ASIST, which assumes a 50/50 sex ratio.

References

Abbot, J., P. J. Lerotholi, M. Mahao, and M. Lenka. 2005. *From condoms to cabbages: Rethinking agricultural interventions to mitigate the impacts of HIV/AIDS in Lesotho.* Paper presented at the

Conference on HIV/AIDS, Food and Nutrition Security, April 14–16, 2005, Durban, South Africa.

Bhattacharjee, P., U. Rani, S. Moses, and J. Blanchard. 2004. *A population-based approach to HIV prevention in vulnerable rural communities of Karnataka, India.* Paper presented at the XVth International AIDS Conference, Bangkok, August 2004, Abstract number: ThPeE8208. http://www.ias.se/ejias/.

Blanchard, J., S. Reza-Paul, and B. M. Ramesh. 2004. *Should geographical intervention replace targeted intervention: A community prevalence study from Bagalkot district of Karnataka, India.* Paper presented at the XVth International AIDS Conference, Bangkok, August 2004, Abstract C12180. http://www.ias.se/ejias/.

Blanchard, J. F., J. O'Neil, B. M. Ramesh, P. Bhattacharjee, T. Orchard, and S. Moses. 2005. Understanding the social and cultural contexts of female sex workers in Karnataka. India: Implications for prevention of HIV infection. *Journal of Infectious Diseases* 191 (Suppl. 1): S139–S146.

Bruce, J., and S. Clark. 2004. *The implications of early marriage for HIV/AIDS policy.* New York: Population Council.

Bryceson, D. F., J. Fonseca, and J. Kadzandira. 2004. *Social pathways from the HIV/AIDS deadlock of disease, denial and desperation in rural Malawi.* CARE International in Malawi.

Campbell, C. 2003. Letting them die: Why HIV/AIDS prevention programmes fail. London: James Currey.

Creese, A., K. Floyd, A. Alban, and L. Guinness. 2002. Cost-effectiveness of HIV/AIDS interventions in Africa: A systematic review of the evidence. *Lancet* 359: 1635–1642.

Decosas, J., F. Kane, J. Anarfi, K. Sodii, and H. U. Wagner. 1995. Migration and AIDS. *Lancet* 346: 826–828.

Ferguson, N., G. P. Garnett, S. Riley, M. Fishbein, W. Pequegnat, and E. Sover. 2002. *NIMH/ASIST: AIDS strategic intervention simulation tool.* Bethesda, Md.: National Institute of Mental Health. www.nimh.nih.gov.

Fernandez, A. 1994. *The interventions of a voluntary agency in the emergence and growth of people's institutions for the sustained and equitable management of micro-watersheds.* Bangalore, India: MYRADA.

———. 2003. *People's institutions managing natural resources in the context of a watershed strategy.* Bangalore, India: MYRADA.

Foss, A., P. Vickerman, B. M. Ramesh, S. Moses, J. Blanchard, and C. Watts. 2004. *The potential impact of microbicides in Bagalkot District, Karnataka, India: Model projections and implications for product promotion.* London: International Family Health. www.ifh.org.uk.

Foss, A., P. Vickerman, and C. Watts. 2004. *The potential impact of microbicides in Bagalkot District, Karnataka, India: Model inputs, calculations and assumptions.* Technical document for Family Health International [unpublished paper available from the authors].

Grassly, N. C., G. P. Garnett, B. Schwartlander, S. Gregson, and R. M. Anderson. 2001. The effectiveness of HIV prevention and the epidemiological context. *Bulletin of WHO* 79 (12): 1121–1132.

Hanumantha Rao, C. H. 2000. Watershed development in India: Recent experience and emerging issues. *Economic and Political Weekly* 35 (45): 3943–3947.

Joy, K. J., and S. Paranjape, with A. K. Kirankumar, R. Lele, and R. Adagale. 2004. *Watershed development review: Issues and prospects.* Bangalore: Centre for Interdisciplinary Studies in Environment and Development.

KSAPS (Karnataka State AIDS Protection Society), ICCHAP (India-Canada Collaborative HIV/AIDS Project), Population Foundation of India, and Population Reference Bureau. 2004. *HIV/AIDS in Karnataka: Situation and response.* Bangalore, India: KSAPS.

Kerr, J. 2002. *Watershed development projects in India: An evaluation.* Research Report 127. Washington, D.C.: International Food Policy Research Institute.

Loevinsohn, M. E., and S. Gillespie. 2003. *HIV/AIDS, food security and rural livelihoods: Understanding and responding.* RENEWAL Working Paper no. 2/IFPRI Discussion Paper no. 157. http://www.ifpri.org/divs/fcnd/dp/papers/fcndp157.pdf.

Loevinsohn, M. E., G. Meijerink, and B. Salasya. 2001. Developing integrated pest management with Kenyan farmers: Evaluation of a pilot project. In: *Assessing the impact of participatory research and gender analysis,* eds. N. Lilja, J. A. Ashby, and L. J. Sperling. Cali: CIAT, pp. 231–247. http://www.prgaprogram.org/modules/DownloadsPlus/uploads/PRGA_Publications/quito.pdf.

Mosse, D., S. Gupta, M. Mehta, V. Shah, J. Rees, and the KRIBP Project Team. 2002. Brokered livelihoods: Debt, labour, migration and development in tribal western India. *Journal of Development Studies* 38 (5): 59–88.

NAC (National AIDS Commission). 2003. HIV sentinel surveillance report 2003. Lilongwe, Malawi: NAC and Ministry of Health and Population.

Ngwira, N., S. Bota, and M. E. Loevinsohn. 2002. *HIV/AIDS, agriculture and food security in Malawi: Background to action.* RENEWAL Working Paper 1. Washington, D.C.: IFPRI. http://www.ifpri.org/renewal/plans.htm.

Parker, R. G., D. Easton, and C. H. Klein. 2000. Structural barriers and facilitators in HIV prevention: A review of international research. *AIDS* 14 (suppl 1): s22–s32.

PFI (Population Foundation of India) and PRB (Population Reference Bureau). 2003. HIV/AIDS in India: The hard-hit states. Fact sheets for Tamil Nadu, Karnataka, Andhra Pradesh, and Maharashtra. Delhi. www.prb.org.

Rafique, A., and B. Rogaly. 2003. *Internal seasonal migration, livelihoods and vulnerability in India: A case study.* Paper presented at the Regional Conference on Pro-Poor Policy Choices in Asia, Dhaka, Bangladesh, June 22–24, 2003. www.livelihoods.org.

Shah, A. 2001a. *Who benefits from participatory watershed development? Lessons from Gujarat, India.* Gatekeeper Series no. 97, London: International Institute for Environment and Development.

———. 2001b. Water scarcity induced migration: How far can watershed projects help? *Economic and Political Weekly* 36 (35): 3405–3410.

Singh, K. 1994. *Managing common pool resources: principles and case studies.* Delhi: Oxford University Press.

Srivastava, R., S. K. Sasikumar, and V. V. Giri. 2003. *An overview of migration in India, its impact and key issues.* Paper presented at the Regional Conference on Migration, Development and Pro-Poor Policy Choices in Asia, June 22–24, 2003, Dhaka, Bangladesh. www.livelihoods.org.

Stover, J., N. Walker, G. P. Garnett, J. A. Salomon, K. A. Stanecki, P. D. Ghys, N. C. Grassly, R. M. Anderson, and B. Schwartlander. 2002. Can we reverse the HIV/AIDS pandemic with an expanded response? *Lancet* 360: 73–77.

Sumartojo, E., L. Doll, D. Holtgrave, H. Gayle, and M. Merson. 2000. Enriching the mix: Incorporating structural factors into HIV prevention. *AIDS* 14 (Suppl. 1): s1–s2.

Turton, C. 2000. *Enhancing livelihoods through participatory watershed development in India.* Working Paper 131, London: Overseas Development Institute.

UNAIDS. 2004. *Report on the global AIDS epidemic 2004.* Geneva: Joint United Nations Programme on HIV/AIDS. www.unaids.org/bangkok2004/report.html.

Washington, R. G., D. Singh, A. Adrien, J. F. Blanchard, S. Moses, and R. Rajdoctor. 2004a. *An evidence-based approach to understanding and addressing rural-to-urban migration in India.* Paper presented at the XVth International AIDS Conference, Bangkok, August 2004, Abstract TuPeD5238. http://www.ias.se/ejias/.

Washington, R. G., J. F. Blanchard, S. Moses, V. Gurnani, D. Bidari, S. M. Jangay, and B. M. Ramesh. 2004b. *The rapidly emerging epidemic of HIV in Karnataka.* Paper presented at the XVth International AIDS Conference, Bangkok, August 2004, Abstract C11783. http://www.ias.se/ejias/.