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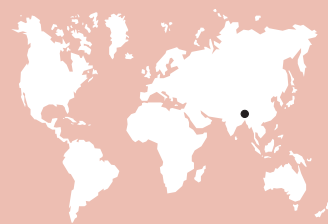
The Dark Side of Light: Managing Non-biodegradable Wastes in Bhutan's Rural Areas

Elizabeth Allison

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While rural electrification brings economic, health, educational, and environmental benefits, it also creates persistent wastes that can have negative implications for human and environmental health. The rural development and environmental management intellectual communities have not worked together sufficiently to manage the non-biodegradable waste products of rural development. In the Himalayan Kingdom of

Bhutan—a nation noted for its vast forests and positive environmental record—the most challenging wastes to manage are those that follow rural electrification: spent light bulbs and fluorescent lights, and small appliances. Based on 6 months of field research in Bhutan, this paper proposes a depot and circuit rider system for the management of non-biodegradable wastes in rural areas.



Rural development

Two-thirds of Bhutan's population lives in rural areas, engaging in traditional subsistence agriculture. Rural development, through road construction and rural electrification, offers better access to markets, schools, and hospitals, and allows the spread of manufactured goods (Figure 1A). Studies of rural electrification have shown that its benefits ripple outward to include increased incomes and economic development, improvements in health and education, protection of water catchment areas and forest environments, and enhancement of gender-balanced development. By providing smoke-free, consistent light, freeing people of indoor air pollution caused by cooking smoke (Figure 1B), and facilitating school children's studies, rural electrification enhances wellbeing. It also brings the challenge of disposing of several new types of non-biodegradable waste: light bulbs, tube lights, and small appliances.

Between 2004 and 2006, 392 additional kilometers of road were built. During

the same period, the number of electrified towns increased by 70%, to include all 68 towns, and the number of electrified villages increased by 24%, to 1318. By 2007, just over half (56%) of rural households used electricity for lighting. Approximately one-quarter (27%) of rural households used electricity for cooking, while nearly two-thirds (57%) still relied on wood. The number of households using electricity will increase steadily in coming years, as the government has set a goal of providing electricity to all households by 2020.

Tourism has played a key role in the economic development of Bhutan. Drawn by vast forests, rich biodiversity, and Tibetan Buddhist culture, foreign tourists pay more than US\$ 200 per day to visit Bhutan, a destination in the Himalayas known for its environmental quality. More than 17,000 tourists—one for every 37 Bhutanese—visited Bhutan in 2006, providing nearly US\$ 24 million in revenue. Having heard that plastic bags are banned in Bhutan, that smoking is not allowed and that 72% of the land remains under

FIGURES 1A AND 1B
A) Electrical lines in the foreground—a sign of ongoing rural development in Bhutan: they bring light and telecommunication to Tomijangsa, a village in Trashi Yangtse, eastern Bhutan. B) By contrast: a traditional, non-electrified kitchen in Zhemgang. (Photos by Elizabeth Allison)



FIGURE 2 A model garbage pit: a two-sectioned, fenced garbage pit at a Basic Health Unit in Tradijung, Zhemgang. (Photo by Elizabeth Allison)



Waste management in rural areas of Bhutan: key findings

Health workers are the primary source of information on waste, sanitation, and hygiene, followed by school teachers.

Until the 1980s, such information was scarce in the rural areas.

In the past 5–10 years, health workers have advised villagers to dig garbage pits.

forest cover, tourists expect an unspoiled environmental icon.

Waste management in Bhutan

Historically, Bhutan's rural areas—ie most of the country—had very little non-biodegradable waste. Even today, much of the household garbage in the villages is organic matter that easily decomposes over time. Villagers use leaves for wrappings. They feed kitchen waste to livestock, or compost scraps in agricultural fields. Because few manufactured products are available, they use bottles and cans for storing milk, oil, and alcohol. Local government health workers advise villagers to burn their garbage in household garbage pits (Figure 2). But villagers throw old shoes, light bulbs, and appliances into ravines, as they are non-burnable, and too big for the garbage pits.

Bhutan's government has identified solid waste management as one of its 5 most pressing environmental problems. Domestic waste constitutes approximately 70–80% of solid waste in both urban and rural areas. The country's main landfill, located in the capital city, has exceeded its capacity for years. The ruggedly mountainous and seismically active terrain poses challenges for siting a new landfill.

Waste at the district level is disposed of in open dumps.

Beyond medical wastes, which are autoclaved and then sent for deep-pit burial, Bhutan presently has no capacity for safe handling of hazardous and e-wastes. These wastes are mingled with the domestic and commercial waste streams in the landfills and open dumps. The National Environment Commission is currently at work on a Waste Management Act, expected to be presented and discussed at the next session of Parliament, which will require that hazardous waste is disposed of in an "approved site or facility," in accordance with the Environmental Assessment Act of 2000. Export to other countries in the region for safe processing may also be an option, provided that those nations provide prior written consent to receive the wastes, in accordance with the Basel Convention.

As part of an integrated effort to understand the quality and quantity of solid waste in Bhutan, the Ministry of Works and Human Settlement invited the author to study attitudes and practices of household waste management. Working with local district officials and staff, she conducted interviews and participant observation in rural areas of 3 *dzongkhags*, or districts, across the country, and Thimphu, the urban capital (see Box). Simultaneously, the Ministry conducted an extensive door-to-door survey of households and businesses in 10 major towns across the country to assess the waste stream. Bhutan's first national waste management meeting in August 2008 provided a forum for the discussion of these and other findings.

Thinking rural development and environmental management together

Because the government is presently developing Bhutan's waste management infrastructure, the time is ripe for thinking through rural development together with environmental management to promote sustainable development. During the author's fieldwork, villagers frequently asked how to dispose of their spent fluorescent 'tube lights.' Their newly gained

indoor lighting had not come with any instructions for disposal.

Containing the neurotoxin mercury, tube lights require special caution. Broken light bulbs can emit vaporous methylmercury, which easily enters the bloodstream, damaging the nervous system, liver, and kidneys, and causing developmental delays in children. Mercury persists in soil and groundwater, where it bio-accumulates and could threaten Bhutan's human population, which relies on surface and groundwater for drinking and irrigation. Mercury in soil and groundwater could also threaten wild species. Moreover, with Bhutan dependent on its niche as an environmentally pristine tourist destination, it is important to maintain the ecological quality of its forests and rivers.

Villagers face potential exposure to the mercury that may escape when the tube lights are broken. And they *will* be broken: how else to dispose of a 3-foot long glass rod on a remote mountain? This glass rod is emblematic of the failure of the rural development and environmental management communities to engage with each other fully. The case of rural Bhutan is used here to illustrate ways in which rural development and environmental management can think through issues together, generating solutions that build social and environmental resilience on many fronts.

Closing the loop for sustainable development

Rural development requires detailed planning for handling the waste generated by broken or spent products. Although 'sustainable development' is on the lips of many policy-makers and practitioners, this does not always include managing the outcomes at the other end of development. Indeed, the focus is generally on the *delivery* of new products and services—through networks of roads and wires—and less on the *disposal* of spent products. Thus, to create truly sustainable development, strategies for waste management and disposal, particularly as related to hazardous and toxic materials, must accompany rural development.

While developed countries have the information and technology to handle hazardous materials in sophisticated ways, developing countries often lack appropriate disposal facilities for hazardous waste. Further, they may lack the training and human resources to handle such waste safely. Disposal of toxic materials is a challenge even in developed countries. How can a developing country with poor infrastructure and challenging terrain handle them?

A proposal: the depot and circuit rider system

This paper proposes a depot and circuit rider system, in which hazardous waste and broken appliances would be collected and transported or repaired by "circuit riders," young waste specialists trained by the government in small appliance repair, and waste collection and reduction (Figure 3). Such a program would address the problem of youth unemployment, while also diverting hazardous waste, protecting Bhutan's villagers from toxic chemicals, and maintaining the quality of Bhutan's forests and rivers. In addition to these positive social and environmental benefits, a collection program could be economically beneficial in supporting tourism, by reducing indiscriminate littering in rural areas, thus protecting the pristine environmental quality for which tourists visit Bhutan.

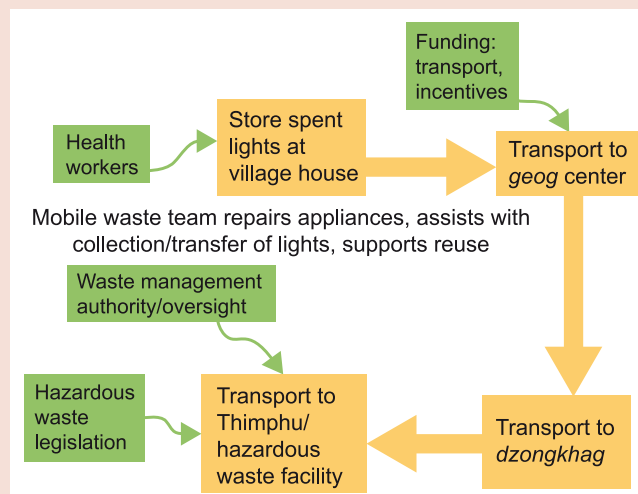


FIGURE 3 Schematic representation of the waste collection system.



FIGURE 4 The proposed waste collection system could complement already ongoing efforts in garbage management: school girls at garbage cleanup day in Haa town. (Photo by Elizabeth Allison)

Building on fluorescent bulb re-collection systems already in existence in the United States, through local governments and retail stores, a depot collection system is proposed for used fluorescent tube lights. While Bhutan and other mountainous developing countries lack the ease of road transport available in the US, it should be possible for them to benefit from similar collection systems, utilizing existing road and track networks, and local government infrastructure. A series of nested collection sites or depots is proposed: spent lights would be collected first at the village level, then at the county or *geog* level, then at the district or *dzongkhag* level, and finally transported to the capital, where the lights could be disposed of according to Bhutanese hazardous waste regulations, currently in development. Because the legal framework for handling hazardous and e-waste is yet to be finalized, transporting waste to Thimphu, the capital, will mean sending it to the landfill, in the short term. However, the Waste Management Act, expected to be enacted by the next session of Parliament, will provide more explicit legal guidance on the handling of hazardous and e-wastes.

Prior to collection by the circuit riders, health workers and school teachers, along with each village's *gup* (village leader), could spread information about the program, reminding people not to throw their tube lights into the forest, and encouraging them to save the light's cardboard packaging for safe re-collection. Each village would collect spent tube lights at one house, and then transfer them to the *gup*. Arranging for a small, refundable deposit to be received when the used and unbroken light is returned would provide an incentive for people not to throw them in ravines.

When the *gup*, or an assistant, travels to the district headquarters, he or she would take the spent tube lights along. In villages without roads, the district government could allocate a small amount of money for hiring ponies for this purpose. The *gup* would deposit the spent tube lights at the district headquarters, at the office of the District Engineer, who would appoint one of his or her staff to oversee the collection and care of the lights. When the District Engineer travels to the capital, he/she would take the spent lights to Thimphu.

Building on a small appliance repair program already in development at the Ministry of Labor and Human Resources, teams of "circuit riders"—high school or college graduates trained in waste reduction and small appliance repair—would visit all the villages within a 2 to 3 *dzongkhag* region. The circuit riders would train others in proper tube light collection and storage, assist with transport of tube lights when necessary, encourage village waste reduction and repurposing initiatives, and repair broken appliances. The circuit riders would provide monitoring and encouragement of the depot collection system. As additional products and facilities are introduced to newly electrified areas, the circuit riders would help devise waste reduction systems.

This program would require government funding for circuit riders' salaries, training, and transportation, as well as for a program manager, cash incentives, and the transportation of spent tube lights. However, relative to the cost of

building a landfill, these costs will be rather minimal. Local monitoring and training could contribute to local waste reduction and avoid future costly cleanups.

The largest challenge will be transporting the bulbs safely across the ruggedly mountainous country, as breakage in transit would increase the hazard to humans and the environment. Light bulb purchasers should keep the bulb's packaging to facilitate safe re-collection. The Bhutanese government might also distribute simple guidelines for turning any cardboard box into a box for carrying a spent light bulb.

This proposal was presented at the first National Solid Waste Management Conference, in Thimphu, in August 2008. The Ministry of Works and Human Settlement, which organized the conference, is currently reviewing the recommendations and conclusions from the conference for presentation to the Prime Minister for further action. The 140 participants in the meeting agreed that public education in waste management is needed throughout the Kingdom, and that hazardous and e-waste must be given more attention for proper collection and disposal. These recommendations have also been discussed informally with villagers, many of whom agreed to store the tube lights in their homes until they

receive further disposal instructions from the government.

Conclusion

Ultimately, less toxic lights that do not require special handling and manufacturer take-back of spent products will contribute greatly to truly sustainable rural development. As both of these advances appear to be years in the future, a collection system for hazardous waste seems to be the best alternative. Although some people might not be interested in handling waste, electronic waste, which appears 'clean' and 'high tech,' may be less objectionable than organic wastes. The collection system proposed in this paper would have several benefits beyond the essential protection of human and environmental health from toxic chemicals. It would help maintain the value of one of Bhutan's main economic drivers, the tourism sector. The program would also provide training and jobs for young people, helping to ease Bhutan's youth unemployment problem and slowing rural-to-urban migration, while nurturing a generation of environmental citizens, thus uniting the issues of rural development and environmental management for truly sustainable development (Figure 4).

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