PERSPECTIVE

RURAL SANITATION CHALLENGES: GATHERING A MULTI-STAKEHOLDER PERSPECTIVE IN YUNNAN, CHINA

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ABSTRACT

This paper examines the adoption and use of "biodigesters", a simple waste-to-energy toilet technology in China. Through interviews with stakeholders directly involved and impacted by water and sanitation development in southwestern China, this paper explores the incentives and barriers to scaling-up biodigesters in rural China. It further examines the extent to which biodigesters are in-line with China's national and local public health priorities, as well opportunities to establish best practices in the emerging private and not-for-profit sectors. After four decades of use in China, the successes and shortcomings of biodigesters are known, and the experience offers valuable lessons to worldwide rural health development and sanitation campaigns.

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摘要: 本文探讨了"沼气池"，一个简单的将有机废物转化为能源的厕所技术，在中国的采纳和使用过程。通过对中国西南地区受水和卫生条件发展直接影响的利益相关者的访谈，本文归纳了在中国农村推广沼气池的激励和障碍。文章进一步探讨沼气池在中国国家和地方的公共卫生重点关注领域的地位，以及建立在新兴的私营和非营利为目的的行业标准做法的可能性。通过沼气池在中国境内四十年的使用，其优缺点已广为人知，也为全球范围内的农村卫生发展和卫生运动积累了宝贵的经验。

In August 2011, the Bill and Melinda Gates Foundation launched a "Reinvent the Toilet" competition, awarding US$3 million to researchers at eight universities and challenging them to design toilet models that operate without sewer connections, water and electricity lines, and cost less than pennies per person per day to use (Eisenberg, 2011). The need for these campaigns is urgent: 2.6 billion people worldwide do not have access to a toilet (Rose, 2008), and diarrhea and water-borne diseases kill more people than HIV/AIDS, tuberculosis, and malaria each year (United Nations, 2006).

In China, with more than 50 percent of the population living in rural areas far away from urban sewage infrastructure, poor sanitation often poses a thorny public health challenge. To address this challenge, preventing fecal pathogens from contacting clean water sources is key. In order to understand how different stakeholders can be better engaged in the effort to upgrade and adopt improved water and sanitation technologies, I spent ten months researching water and sanitation programs in Yunnan, where many villages are plagued by water-scarcity issues and rural poverty (Whines, 2010). I was able to examine the local factors that shape how people perceive and value improved sanitation.

BACKGROUND

Biodigesters are one solution to address the need for toilets. Household biodigesters are underground, airtight septic tanks connected to "outhouse" toilets. This design minimizes the risk of contamination to local water tables and reduces the spread of parasitic diseases by collecting human and animal waste in an enclosed tank. Through a process of anaerobic (oxygen-less) fermentation, the digester produces a pathogen-free fertilizer and a flammable gas for lighting and cooking. A major health benefit is improved indoor air quality by reducing villagers' dependence on wood and coal burning stoves. The digester also produces a residual organic fertilizer that can

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be safely used on crops, allowing China to move away from its intensive use of chemical fertilizers and pesticides, currently exceeding international standards.

THE SHORTCOMINGS

With financial help from national and local authorities, biodigesters have been installed in households and communities in China since the 1960s, with the total number estimated at nearly 35 million units (Remais et al., 2009). While the technology sounds like a perfect solution to a number of pressing concerns, the household biodigester has its shortcomings. The initial investment for construction can cost roughly 30 percent of a family's annual earnings (average annual income of 6000 RMB). Considerable investment remains despite government subsidies (ranging between 500 and 1500 RMB) to cover construction and material costs. Since 2003, the National Rural Biogas Construction Program has also been providing subsidies nation-wide.

Some farmers I interviewed claimed that they did not receive the full subsidy that the government promised. Farmers recalled showing up at the local energy bureau to claim the biodigester subsidy and being told that their subsidy was deducted for labor wages, transportation costs, and installation fees. China's notorious bureaucratic fragmentation is partially to blame; what is dictated by the central government is not practiced at the local level.

Maintenance is another major concern for biodigester toilet users. Yunnan has been a historical site of poverty alleviation projects, and it is common to see several generations of biodigesters sitting side-by-side in villages, some still working while others abandoned. One reason for inconsistent maintenance and upkeep is that biodigesters are a labor-intensive investment. After receiving training from the local government, farmers are expected to independently dig pits for the unit. This is a large labor trade-off for farming communities that is not covered by government subsidies.

If a problem arises after installation, farmers have to either repair the digester by themselves or call the rural energy bureau to come and fix it. Most farmers do not fully understand how the digester works to make repairs on their own, and the government lacks the personnel and financial resources to fill this knowledge gap. In Yunnan, for example, aside from rural energy bureaus, there is only one company, ZhenHe NengYuan, that provides biogas maintenance services for Yunnan's 2.1 million rural biogas units. Consequently, a lack of community acceptance, ownership, and household participation in projects could limit the diffusion of biodigesters.

STAKEHOLDER PERSPECTIVE

Farmers

Reducing farmers' out-of-pocket health expenditures is a top government priority in China (KPMG, 2011), so it is not surprising that majority of farmers have built biodigesters with government support, covering material and construction costs. In dozens of household interviews, only one family independently installed their digester without government's financial assistance. The male head of the household said that he invested in his family's biodigester because it produces rather than consumes energy and improved his family's living standards.

My perception of biodigesters being promoted, first and foremost, as a tool to improve public health was challenged, however, by the fact that financial subsidies are coming from provincial forestry and agricultural bureaus, rather than health authorities. It turns out that local forestry bureaus have been supporting biodigesters because they are a deforestation prevention measure: the methane-based biogas produced by the digesters cuts down on the burning of wood and coal for household cooking stoves. The environmental impact of deforestation and carbon dioxide emissions is offset. Financial subsidies are also coming from local agricultural bureaus because they

use biodigesters as a money-saving technology for farmers: the fertilizer produced by the digester limits expenditures on chemical fertilizers and also efficiently increases crop yield.

Village Doctors

Given that biodigesters are being subsidized by government authorities for reasons other than their public health benefits, sanitation is not being directly addressed and still remains a major public health burden in rural areas. When I asked village doctors to name the most burdensome public health concern, water and sanitation issues consistently made it to the top: diarrhea remains the second-most deadly infectious and parasitic disease in China: it is responsible for one of every 100,000 deaths (Ma et al., 2008).

Villages that have yet to benefit from government subsidies, or households located at too high an altitude to maintain a suitable temperature for biogas fermentation, rely on open pit latrines. Come summer, uncovered latrines attract flies. In the rainy winter season, human waste from open-air latrines runs into the street where pedestrians pick up bacteria on their shoes and bring it into their homes. Both sources of waste contamination result in doctors treating a steady source of patients suffering from diarrhea.

Diarrheal treatment burdens China's already strained medical system. When a child is sick with diarrhea, parents rush the child to doctors demanding an injection of antibiotics and an IV drip. Until more recently, doctors have relied heavily on drug prescriptions to make up for operating budget shortfalls. The overreliance on antibiotics for managing diarrheal illness should be alarming given that China currently has the world's highest levels of growing antibiotic resistance (Zhang et al., 2006).

Public Health Officials

If public health officials did more to both quantitatively and qualitatively measure the public health impacts of biodigesters, perhaps their full benefits could be understood. However, the recurring theme in Yunnan's more remote third and fourth tier cities is that county and city health officials are under constant pressure to manage competing public health priorities, such as chronic disease management, basic health services and human resources, and improving access to clean water and sanitation. When asked about sanitation conditions, one health bureau director lamented that his hands are tied by underfunded health mandates continuously being handed down by the government. By some accounts, local governments account for nearly 80 percent of public spending despite receiving less than half of all tax receipts (Man et al., 2010).

Underfunded public health mandates and competing health priorities are overshadowing pressing water and sanitation concerns. It is also worrisome that 70 percent of water samples across Yunnan fail to meet water quality standards. Researchers in the Environmental Health Division at Yunnan's Center for Disease Control and Prevention told me that among the impediments to improving rural water quality and availability, water pollution from human and animal fecal contamination remains a top concern. According to national figures, agricultural pollution accounts for 43 percent of the country's water pollution (Watts, 2011); livestock waste is a major culprit, with only 20 percent of excrement being treated. The Chinese government's 12th Five-Year Plan aims to crack down on water pollution (Tang, 2011). The Plan calls for reductions in carbon dioxide and sulfur dioxide by 8 percent, and in ammonia nitrogen and nitrogen oxides by 10 percent each. Whether the new standards will translate to reductions in water-related and waterborne diseases remains largely up to government enforcement and implementation.

Nongovernmental and Private Sector

New programs promoting biodigesters deserve attention. Two pilots, in particular, are adding a new spin to wastewater management and have the potential to dramatically shift how researchers think about water and sanitation development.

Initiative Dévelopement (ID) is a French NGO in Yunnan piloting projects that apply carbon credits to finance the construction and maintenance of household biodigesters. With financial backing from the French Development Agency (FDA) and the Sino French Cooperation on Climate Change, the project uses the Gold Standard, an international carbon-trading mechanism to transfer carbon revenue to China's Ministry of Finance and provincial Clean Development Mechanism (CDM) centers. ID's aim is to assure the long-term maintenance of biodigesters over their 20-year lifespan. In talking with people involved with this project, I learned that ID also supports training for local maintenance and building crews and educates communities on how to use their digesters properly. The human capital investment will be the key to long-term success.

In the private sector, the Huijia Peike hog farm outside of Kunming, Yunnan's capital, is using a large-scale biodigester to treat up to 150 tons of pig waste per day, removing up to 90 percent of livestock waste pollutants that would otherwise contaminate nearby water sources. While a small portion of the biogas generated is used to power onsite facilities, the remaining gas is piped at no cost to 42 households in a nearby village (Ni, 2011). To support this arrangement, the local county government subsidized households' installation of biogas-operated cooking appliances, such as stoves and rice cookers. Each year, this biogas saves villagers 600 RMB in fuel costs, while limiting deforestation and indoor air pollution from cooking fires.

Huijia Peike Pig Breeding Company has Yunnan's first large-scale biodigester at a factory farm, which is part of a growing trend of large livestock farms adopting similar approaches to waste management (Barclay, 2010). The use of commercial biodigesters on livestock farms has in part been prompted by tightening industry wastewater treatment requirements and stricter discharge standards set by the Ministry of Environmental Protection (Zhang, 2010). In addition, large-scale, integrated systems have the potential to operate with greater returns to waste management by centralizing collection systems, and reducing the risk of isolated leakages from poorly managed cesspools. Similar efforts deserve more attention in order to determine best practices in biodigesters adoption coming from the private sector.

KEY LEARNING

The story of biodigesters in Yunnan illustrates that water and sanitation development require a coordinated effort across sectors, such as infrastructure and medicine, and also between governments, businesses, NGOs, health practitioners, and rural communities. It remains crucial that the government continues to offer financial incentives to communities and businesses, along with increasing outreach, education, and technical assistance to make the biodigester toilet a viable sanitation option.

China is surpassing the majority of its East Asian neighbors in terms of improved sanitation,[†] but there is still much room for improvement to reach China's sanitation targets. Technology and engineering alone will not provide a one-off solution to water problems facing China or the world. The key issue with biodigesters, as with other water management technologies, is proper implementation. If high standards of operation can be maintained, biodigesters have a strong potential to be scaled-up as a sustainable means of rural development.

[†] *According to the WHO, China's annual incidence rate of diarrheal disease had dropped to 154 cases per 1,000 people in 2008, a rate lower than all East Asian countries except Japan and South Korea.*
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