Outdoor Air Pollution

The Problem

With an average annual production of 200 billion bricks per annum, India is the second largest producer of bricks in the world, after China. India's share is nearly 14 percent of the global brick production. Over the last 40 years brick production has increased by more than 8 times, due to growing demand from the housing and infrastructure sectors. Around 35 million tonnes of coal is consumed in the sector and is the third largest consumer of coal in the economy after thermal power, iron and steel. Brick is also a major contributor to environmental pollution as it depends heavily on natural resources, like soil (e.g. top fertile alluvial soil in the Indo-Gangetic plains), and coal. The average estimated CO2 emission from the sector is more than 60 million tonnes.

The predominant technology that is used for brick manufacturing in India is Fixed Chimney Bull's Trench Kiln (FBTK). This accounts for nearly 70 percent of the total brick produced in the country. However, other technologies that find application include Clamp Kilns, which produce bricks in batches where operation might be happening at relatively smaller scales, and are widely used in the peninsular region, contributing to about 25 percent of the total brick production.

The brick kilns in Rajasthan are located in three major districts i.e. Jaipur, Hanumangarh and Sri Ganganagar. Interestingly, ambient air quality monitoring takes place only at Jaipur out of three key brick producing districts in the state. Reports suggest that Sri Ganganagar has the highest share of brick kilns in the state. There are violations of particulate matter (PM) 10 concentrations at most of the monitoring stations in the districts. Based on the estimates of the global burden of disease methodology, Rajasthan recorded more than 65000 deaths due to exposure to PM 2.5. Further, an estimated around 801 deaths have been attributed due to brick kilns in the state.

There are variations in the average yearly concentration across these stations. For example, VKIA has the highest concentration, (>250 microgram/m3), while Jhalana Doongari has the least mean concentration of 125 microgram/m3 among all the locations where ambient air quality monitoring takes place and as recorded during the 9 months of a year when brick manufacturing takes place

The economic and social benefit-cost assessment undertaken in this study looks at two options of cleaner kiln technologies in the state of Rajasthan. The two options involve improvement of existing Clamp Kilns and (and FCBTK technology) to the Zig-Zag Kilns, and Vertical Shaft Brick Kilns (VSBK) technology.

Solutions

Interventions	BCR	Benefits (INR crores)	Cost (INR Crores)
Improved Zig-Zag Kiln	7.9	12,378	1,560
Vertical Shaft Brick Kiln Technologies (VSBK)	7.3	17,493	2,400

Total costs and benefits are discounted at 5%.

Get the full paper by economist **Souvik Bhattacharjya** Fellow Centre for Resource Efficiency and Governance The Energy and Resources Institute (TERI) on www.rajasthanpriorities.com/environment-and-climate-change.

Improved Zig-Zag Kiln

The Problem

Coal is the main source of energy for brick kilns. The use of large quantities of coal and petcoke in brick kilns contributes significantly to emissions of carbon dioxide (CO2), and particulate matter (PM). It is estimated that, around 35 million tonnes of coal is consumed in the sector and is eventually the third largest consumer of coal in the economy after thermal power, iron and steel.

Emissions largely arise from inefficient combustion of large quantities of coal, petcoke and agri-residues that are used in brick kilns which has serious health and mortality implications.

The Solution

Clamp kilns and/or FCKs can be converted to Improved Zig-Zag Kilns at low costs in the lowlands at the same site. This can be accomplished in less than half a year.

The production capacity is the same or higher compared to the Clamp kilns and/or FCBTKs. The brick quality is as good as or better than FCBTKs, and with energy savings and PM emission reductions.

Costs

Using the estimated average production per kiln, and the capital cost per kiln, the total capital cost of intervention has been estimated at Rs. 1,560 crores.

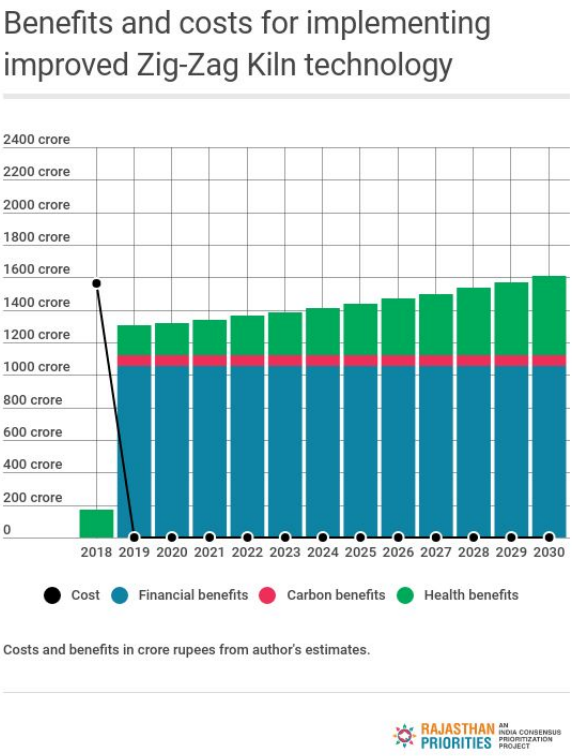
Benefits

The financial benefits for Zig-Zag technology has been estimated for a period of 12 years (till 2030). It has been found that the production of class I bricks can increase from 50 percent to 80 percent in case of Zig-Zag technology.

Zig-Zag brick manufacturing leads to 22 percent lower CO2 emissions. The savings of carbon emission per year are 1.27 million tonnes CO2. The average number of lives to be saved per year is 362 in case of Zig-Zag technology.

Financial benefits dues to this intervention is estimated at Rs. 8,911 crores. The social benefits of cleaner brick kilns assessed in this study are health benefits (Rs. 2,723 crores) of reduced PM 10 emissions and global benefits of carbon dioxide (CO2) emission reduction (Rs. 743 crores) due to higher energy efficiency of Zig-Zag technology.

The total benefits due to conversion to Zig-Zag technology is Rs. 12,378 crores at 5% discount rates.



Vertical Shaft Brick Kiln Technologies (VSBK)

The Problem

Brick Klin technology that is largely predominant is Fixed Chimney Bull's Trench Kiln (FCBTK), which are less efficient in terms of energy consumption and quality brick production, than other technologies.

The Solution

The VSBK technology uses hot exhaust gases for the gradual preheating of the unfired bricks in a continuous process, thus reducing energy consumption and CO2 emissions compared to the more commonly used clamp kilns/FCBTK. VSBK technology is one of the most energy efficient and cost-effective brick firing processes in the world, with the added benefit of providing a better working environment for staff members.

The VSBK makes clay brick an even more sustainable building option by reducing the embodied energy of an average clay brick, at least by half. It is important to note that VSBK brick manufacturing leads to 53 percent lower CO2 emission than existing brick manufacturing process.

Costs

The total capital cost of intervention has been estimated at Rs. 2,400 crores.

Benefits

With VSBK technology, the production of class I bricks can be as high as 90 percent. Further, VSBK technology can lead to an incremental financial benefit of Rs 11,760 crores at 5% discount rates. The social benefits of cleaner brick kilns assessed in this study are health benefits of reduced PM10 emissions and global benefits of carbon dioxide (CO2) emission reduction from improved energy efficiency. A retrofitting with a VSBK technology is estimated to reduce CO2 by 2.72 million tonnes.

The avoided CO2 costs have been estimated to be Rs 1,589 crores at 5% discount rates. In the presence of VSBK technology, an estimated 6611 deaths can be avoided, thereby improving quality of life between 2019 and 2030. This is equivalent to 551 deaths saved per annum. The incremental health benefits are estimated at Rs. 4,143 crores.

The total benefits due to conversion to VSBK technology is Rs. 17,493 crores at 5% discount rates.