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Increasing heat creates hardship for brick kiln workers in Chennai, India and the alternative pathways reducing it

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RESEARCH ARTICLE

Climate change brings new burdens to people working outdoors. Migrant populations working at brick kilns in India are one such group facing dangerously overheated working conditions. Many migrate to the kilns from rural areas under bonded labor conditions. We argue that solutions need to go beyond industry-oriented technology-based solutions and focus on the social problem and take a people focused stance. In addition to adopting more locally appropriate technologies to reduce greenhouse gas emissions and heat in the work environment, solutions focusing on the workers situation must be considered from a human rights perspective.

Introduction

Vulnerable populations worldwide tend to be the most exposed to the unjust burden of climate change consequences [N. Klein, 2009], [NDMA, 2016], [UNEP, 2011]. One consequence of climate change is more extreme heat [IPCC, 2013] and an increased frequency of heat waves [R.S. Kovats and S. Hajat, 2008]. Climate change is expected to worsen the dry season, and increase rural-to-urban migration.

India's brick kiln sector employs millions of migrant workers [SDC, 2008], who are at risk from extreme heat exposure. India's booming economy drives demand for bricks [S. Kumbhar et al., 2014] in the periphery areas bordering India's growing cities. Clay bricks are used to build warehouses and workplaces [SDC, 2008].

This paper is based on a scientific publication [K. Lundgren-Kownacki et al., 2018] where we focused on brick production in Chennai, India to examine the health impacts from overheating, which can range from heat stress, stroke, dehydration, respiratory and cardiovascular ailments, to kidney failure [K. Parsons, 2014]. As average global temperatures continue to increase [IPCC, 2013], new approaches are needed to reduce the risk of extreme heat exposure on people.

The combined risks posed by known negative health impacts from heat, alongside the risk of migrant workers being exploited, creates a double-marginalization. We first evaluated the current and forecasted heat risks in Chennai's brick kilns. We then used a transdisciplinary analytic approach to identify potential solutions to this double-marginalization.

Assessing heat stress impacts on people

The negative effect of high heat on human health has been well established through physiological, medical and epidemiological research. High exposure to heat may decrease life expectancy [K. Parsons, 2014]. People who carry out heavy physical labor are at risk because their work exposes them to more heat stress. At brick kilns, heat from radiation originates from both the sun and the kiln.

To assess the heat exposure risk experienced by a person at work, six environmental and human-dependent factors have to be considered. The environmental factors include air temperature, radiant temperature, humidity and air movement. The human-dependent factors include clothing and physical activity (i.e. metabolic heat production) [K. Parsons, 2014].

[K. Parsons, 2014] summarizes the quantitative methods available to evaluate health risks from heat exposure and the specific impact of each variable. The factors are usually measured in combination in order to calculate a *heat index* that identifies thresholds for heat stress. The Wet-Bulb Globe Temperature (WBGT) is a common type of heat index, and was chosen as the heat index used to evaluate environmental heat stress in our study [ISO, 2017]. It was measured using the instrument shown in Figure 1.

Figure 1. Picture of a WBGT measurement instrument (QUESTemp) at one of the brick kilns studied [K. Lundgren Kownacki, 2018].

The international standard for the WBGT index applies a formula based on measurements of three temperature factors: 1) the air temperature measured with a shielded thermometer in order to protect it from radiative heat as the latter is measured separately by the second variable; 2) the globe temperature, which is the measured temperature inside a black globe; and 3) the natural wet bulb temperature, which is measured with a wet cloth over the sensor representing the heat loss achieved through the evaporation of sweat [ISO, 2017].

The human-dependent factors, clothing and physical activity, were evaluated using several methods. Firstly, observations and measurements of both heart and sweat rates of people working at the kilns were collected. Secondly, laboratory simulations of the work performed at the kilns were also conducted which included oxygen consumption measurements that are more accurate than observations and/or heart rate measurements. Finally, the insulation properties and evaporative resistance (how well the fabric breathes) of the clothing worn by people working in kilns were evaluated using a ‘thermal manikin’ in laboratory conditions.

The study revealed that people currently working at the kilns are already experiencing extreme heat exposure in the hot months, with the WBGT index often exceeding international guidelines for work in hot environments (of around WBGT 28° C for acclimatized workers under moderate workload) [ISO, 2017]. Most workers in the Chennai kilns had moderate workloads corresponding to a metabolic heat production of between 130 W/m^2 to 200 W/m^2 [ISO, 2004], [K. Lundgren et al., 2014]. Work clothing was found to add further heat stress, particularly for women, due to the number of clothing layers and types of fabrics worn [G. Havenith et al., 2015], [K. Lundgren et al., 2014].

Some climate models have forecasted that WBGT temperatures will climb above the safe resting limit in Chennai by the end of the century [ClimateCHIP, 2019]. Given these potential thermal futures, the need for radical interventions becomes apparent.

What can be done to intervene in an increasingly dangerous situation? Our study used a transdisciplinary approach to attempt to reframe the problem from being a physical problem requiring high-tech solutions, to a social problem that requires a more people focused stance. Transdisciplinarity generally refers to the combination and integration of knowledge from different specialties, especially as a way to shed light on a problem from different angles. We present two key interventions that diverge from the high-tech solutions typically suggested by engineers for India's brick kiln crisis.

The people focused, locally appropriate technology alternative

From the analysis made in [K. Lundgren-Kownacki et al., 2018], the first intervention identified is a locally appropriate alternative technology pathway. In Chennai, the opportunity to switch from fired bricks to sun-dried mud/clay bricks could provide the workforce safer job opportunities with less heat stress, while reducing the dependency on energy-consuming, heat-inducing production techniques.

Black carbon (i.e. soot) emitted from coal-fired kilns is a major health hazard, causing harm to major body parts when inhaled [J. Löndahl et al., 2010]. In addition to reducing health risks, the switch from coal-fired bricks to sun dried bricks would eliminate greenhouse gas emissions and other combustion by-products released by fired brick manufacturing process [S. Menon et al., 2002]. Removing black carbon emissions could therefore significantly reduce the rate of warming [UNEP, 2011]. Brick kilns are estimated to consume roughly 25 million tons of coal per year, making them among the highest industrial consumers of coal in India [CATF, 2012], [UNEP, 2011].

Switching to sun-dried mud/clay bricks would change the way bricks are made, making the process itself less hazardous for workers, and less polluting for the environment. Two environmentally friendly and low impact alternatives to fired bricks are 1) compressed earth blocks built of loamy soil earth, and 2) sun dried mud/clay bricks. Compressed earth blocks can be produced using hydraulic machines, whereas sun dried mud/clay bricks do not require machines, only the power of the sun. This makes sun dried bricks a more appropriate technology as local people would be able to create and repair all the tools needed for this approach, as was the case historically with skilled local craftspeople.

The clay used in the production of the bricks could be locally sourced before mixing and the wooden molds that the clay is pressed into during the final production step could be produced within India's forested regions. The use of locally sourced materials could provide social and economic benefits while reducing production costs compared to using imported industrialized building methods and materials [J.C. Morel et al., 2001].

For example, sun dried mud/clay bricks can be cast in molds on-site quickly, using local materials, allowing mass production of bricks in a short time. One study has shown that one person can cast over 600 bricks in seven working hours [M. Dabaieh, 2011], [M. Dabaieh, 2013].

Using the sun as a free and abundant source of heat to dry bricks, rather than burning coal is possible in Chennai. Experiments elsewhere using sun-dried bricks have demonstrated their viability, feasibility, and economic benefits. [H. Fathy, 1973] and [J.F. Kennedy, 2004] show that using local earth materials in buildings is energy efficient, low in toxicity, safe, and durable [H. Fathy, 1973], [J.F. Kennedy, 2004]. Low energy intensive earth building materials could reduce carbon dioxide (CO_2) emissions [J. May, 2010], [R. Rael, 2009]. Sun-dried bricks can be used in fighting climate change by acting as CO_2-absorbing sinks if lime is added to the clay mixture, as lime helps absorb CO_2 out of the air while improving the water resistance of the bricks [B. Jones, 2005].

People focused human rights alternative

The second intervention identified based on [K. Lundgren Kownacki, 2018], is a human rights alternative pathway to empower both local and migrant people working and living at brick kilns.

Even though India has banned forms of bonded labor, including child labor, bonded labor continues to be common practice throughout India's brick industry due to weak law enforcement [I. Guérin et al., 2012]. Bonded labor is a form of forced labor that is typically paid below the minimum wage and reinforced by custom or force, characterized by a creditor-debtor relationship between the employer and the employee [Ravi S. Srivastava, 2005]. Families, including young children, work in harsh, low-paying conditions, commonly compensated piece by piece [R. Khandelwal, 2012]. The International Labour Organization stated in 2005 that brick kiln work is a prominent example of contemporary forced labor situations [Ravi S. Srivastava, 2005].

While most literature on brick kiln sites tend to focus on the occupational health hazards [L.R. Inbaraj et al., 2013], [S. Pingle, 2012], our transdisciplinary re-framing of the kiln issue took a human rights perspective. This enabled our study team to extend our literature review beyond the occupational hazards or the focus on economic metrics such as labor productivity [UNDP, 2016]. Our study included mass media documentation of bonded labor working conditions, including heightened media coverage in 2014 [O. Wainwright, 2014], which quickly enabled our team to reframe the problem in a people focused way that reconsidered people working at the kilns as far more than human capital on the labor market measured against economic indicators for labor productivity.

Re-framing the problem required a social lens to re-label our study population from being kiln workers to their original identity: they are displaced rural people, including subsistence farmers forced to migrate to work at brick kilns [S. Sengupta, 2007]. The displaced farmers are victims of commissioned contractors who go to villages seeking debt-burdened families to lure through a lump sum of money so by accepting work at brick kilns the family can pay back debts and buy foodstuffs [G.M. Molankal, 2008].

This social reframing helped us to see how rural people fell into the debt bondage trap after the neoliberal structural adjustments of the 1990s. These adjustments destroyed the local village markets and rural subsistence livelihoods. Identifying the formerly faceless migrants as being former rural subsistence farmer families makes it possible to reframe the challenge from being how to make brick kilns safer for workers, to how to provide tools to rural subsistence farmers that allow them to regain power they had lost.

We used reframing to expand the solution space to include a broader set of emancipatory social objectives that reveal the vulnerability of migrant workers as an indicator of a loss of human rights of rural peoples. We identified three solution spaces to recover the human rights lost by rural peoples: 1) local democratic influence, 2) village self-sufficiency; and 3) subsistence rights.

The red thread running through all three solution spaces is the need for people focused re-localization. This could be described as a process wherein people reaffirm control of their lives, putting culture and dialogue back at the heart of their efforts to liberate society [V. Liegey et al., 2015]. Thus re-localization enables not only local democratic influence, but also village self-sufficiency, and subsistence rights.

Open re-localization can be used as a way to facilitate dialogue-driven, power sharing community arrangement(s) between diverse ethnic and religious communities that promote non-violent outcomes, protecting human rights and ecological sustainability [V. Liegey et al., 2015]. This shift to local economic decision-making would help diverse communities to regain control of what they produce and exchange, such as the low polluting, carbon neutral, no-heat producing appropriate technology solutions we discuss.

One strategy that could mobilize open re-localization in all three solutions spaces would be through Social and Solidarity Economy (SSE) practices. SSE is used by organizations that are pursuing social aims and fostering solidarity [ILO, 2014] by enabling local individuals and organizations to achieve common goals [ILO, 2002]. Rather than formulating a top-down strategy, solutions could be co-created by local populations by inclusive, repeated participatory processes, and decentralized governance used to regain self-sufficiency at the village level.

Village self-sufficiency was suggested by the Delhi-based Centre for Science and Environment in their 1995 video The Village Republic, which followed up on their 1989 landmark publication, ‘Towards Green Villages: A Strategy for Environmentally-Sound and Participatory Rural Development’. The publication documented the regenerative rural work found within India’s villages in the 1970s and 1980s as practical examples of the Gandhian Village Republics concept [*“CSE Timeline”*, 2017].

The Global Initiative for Economic, Social and Cultural Rights (GI-ESCR) also stress that “social injustice is inextricably bound up in ecological injustice” and the need for designing interventions that address “all humans’ needs and capabilities, rather than the accumulation of wealth” as a way to secure human rights within ecological boundaries [GI-ESCR, 2014]. Questioning the fundamentals from a human rights re-framing could protect people from extreme heat exposure by addressing their desires for re-shaping their own lifeworlds in a hotter world.

Conclusion

Heat at brick kilns around Chennai is already at the limits of what humans can tolerate before risking serious health impacts. The working conditions at the kilns in Chennai create issues ranging from the health impacts of extreme heat exposure, to human rights violations at the kilns, and finally to the need to reduce greenhouse gas pollution through locally appropriate technical solutions. Our analysis takes an integrative, transdisciplinary analytic approach that promotes a range of technical and socio-culturally informed solutions. We argue that our solutions for people at kilns will help enable a transition that includes a mix of locally appropriate technologies and human rights-based approaches. This could lead us towards environmentally sustainable, human rights-based outcomes.

Bibliography

- *CSE Timeline*. CSE (Centre for Science and Environment). Retrieved (2017) from https://www.cseindia.org/cse-timeline-218.
- CATF: Brick kiln performance assessment – a roadmap for cleaner brick production in India, Clean Air Task Force, 2012. Retrieved from http://www.ccacoalition.org/sites/default/files/resources/Brick_Kilns_Performance_Assessment.pdf.
- ClimateCHIP: . Climate change health impact and prevention – your area. Retrieved (1 2019) from http://www.climatechip.org/your-area-climate-data.
- M. Dabaieh: A future for the past of desert vernacular architecture: testing a novel conservation model and applied methodology in the town of Balat in Egypt, Dissertation, Lund University, Sweden, 2011.
- M. Dabaieh: Can vernacular help urban poor? Dimensions of urban poverty and future directions using vernacular solutions. Cities to be tamed, standards and alternatives in the transformation of urban south, Politecnico di Milano, 15-17 November, 2012. Milan, Italy, *Planum, the journal of Urbanism*, vol. 26, 2013.
- H. Fathy: Architecture for the poor: an experiment in rural Egypt. University of Chicago Press, 1973.
- GI-ESCR: A human-rights based approach to the environment and climate change: A GI-ESCR Practitioner's Guide, Global Initiative for Economic, Social and Cultural Rights, Geneva, 2014. Retrieved from http://globalinitiative-escr.org/wp-content/uploads/2014/03/GI-ESCR-Practitioners-Guide-Human-Rights-Environment-and-Climate-Change.pdf.
- I. Guérin, S. Ponnarasu, G. Venkatasubramanian and S. Michiels: Ambiguities and paradoxes of the decent work deficit: bonded migrants in Tamil Nadu, *Global Labour Journal*, vol. 3, 118-142, https://doi.org/10.15173/glj.v3i1.1115, 2012.
- G. Havenith, S. Hodder, Y. Ouzzahra, D. Loveday, K. Kuklane, K. Lundgren, J. Fan and J. Au: A database of static clothing thermal insulation and vapor permeability values of non-western ensembles for use in ASHRAE standard 55, ISO 7730 and 9920: results from project 1504-RP, *ASHRAE Transactions*, vol. 121, 197-215, 2015.
- ILO: Promotion of Cooperatives Recommendation, Informatin System on International

Labour Standards, International Labour Organization, 2002. Retrieved from http://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:12100:0::NO::P12100_ILO_CODE:R193.

- ILO: The Social and Solidarity Economy, Publication, International Labour Organization, 2014. Retrieved from http://www.ilo.org/empent/Publications/WCMS_175515/lang–en/index.htm.
- L.R. Inbaraj, O.J. Haebar, F. Saj and and co-authors: Prevalence of musculoskeletal disorders among brick kiln workers in rural Southern India, *Indian Journal of Occupational and Environmental Medicine*, vol. 17, 71-75, https://doi.org/10.4103/0019-5278.123170, 2013.
- IPCC: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, T.F. Stocker, D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and co-editors (Eds.). Cambridge University Press, 1535 pp., 2013.
- ISO: Ergonomics of the thermal environment—determination of metabolic rate, ISO8996:2004, Standards, International Standardization Organization, 2004.
- ISO: Hot Environments – Estimation of the heat stress on working man, based on the WBGT- index, ISO7243:2017, Standards, International Standardization Organization, 2017.
- B. Jones: Building with straw bales: a practical guide for the UK and Ireland. Green books, Foxhole, 2005.
- J.F. Kennedy: Building without Borders: sustainable construction for the global village, J.F. Kennedy (Eds.). New Society Publishers, Gabriola BC, 2004.
- R. Khandelwal: Internal migration and labour market integration: Breakthroughs in organizing and collectivizing migrant workers in India, International Organization for Migration. Geneva, Switzerland, 2012. Retrieved from http://publications.iom.int/system/files/pdf/migrationpolicypracticejournal_11sept2012.pdf.
- N. Klein: *Climate Rage*. Rolling Stone Magazine. Retrieved (11 2009) from http://www.rollingstone.com/politics/news/climate-rage-20091112.
- R.S. Kovats and S. Hajat: Heat Stress and Public Health: A Critical Review, *Annual Review of Public Health*, vol. 29, 41-55, https://doi.org/10.1146/annurev.publhealth.29.020907.090843, 2008.
- K. Lundgren Kownacki: The heat is on: Evaluation of workplace heat stress under a changing climate, PhD thesis, Department of Design Sciences, Faculty of Engineering, Lund University, 2018.
- S. Kumbhar, N. Kulkarni, A.B. Rao and B. Rao: Environmental life cycle assessment of traditional bricks in western Maharashtra, in: India Energy Procedia, 260-269, https://doi.org/10.1016/j.egypro.2014.07.269, 2014.

- V. Liegey, M. Stéphane, O. Christophe and V. Anisabel (11 2015): Neither protectionism nor neoliberalism but ‘open relocalization’, the basis for a new International / Ni protectionnisme, ni néolibéralisme mais une ‘relocalisation ouverte’, base d’une nouvelle internationale, *Basta!*. Retrieved from http://www.bastamag.net/Ni-protectionnisme-ni-neoliberalisme-mais-une-relocalisation-ouverte-base-d-une.
- K. Lundgren, K. Kuklane and V. Venugopal: Occupational heat stress and associated productivity loss estimation using the PHS model (ISO 7933): a case study from workplaces in Chennai, India, *Global Health Action*, vol. 7, https://doi.org/10.3402/gha.v7.25283, 2014.
- K. Lundgren-Kownacki, S. Kjellberg, P. Goosh, M. Dabieh and V. Venugopal: Climate change induced heat risks for migrant populations working at brick kilns in India: A transdisciplinary approach, *International Journal of Biometerology*, vol. 62, 347-358, https://doi.org/10.1007/s00484-017-1476-0, 2018.
- J. Löndahl, E. Swietlicki, E. Lindgren and S. Loft: Aerosol exposure versus aerosol cooling of climate: what is the optimal emission reduction strategy for human health?, *Atmospheric Chemistry and Physics*, vol. 10, 9441-9449, https://doi.org/10.5194/acp-10-9441-2010, 2010.
- J. May: Handmade houses and other buildings: the world of vernacular architecture. Thames & Hudson, London, 2010.
- S. Menon, J. Hansen, L. Nazarenko and Y. Luo: Climate Effects of Black Carbon Aerosols in China and India, *Science*, vol. 297, 2250-2253, https://doi.org/10.1126/science.1075159, 2002.
- G.M. Molankal: Migration, a Survival Strategy Case of Brick Kiln Workers in Barak Valley, Assam, *Rajagiri Journal of Social Development*, vol. 4, 2008.
- J.C. Morel, A. Mesbaha, M. Oggerob and P. Walker: Building houses with local materials: means to drastically reduce the environmental impact of construction, *Building and Environment*, vol. 36, 1119–1126, https://doi.org/10.1016/S0360-1323(00)00054-8, 2001.
- NDMA: Guidelines for preparation of action plan — prevention and management of heat-wave, National Disaster Management Authority, Government of India, 2016. Retrieved from http://www.ndma.gov.in/images/guidelines/guidelines-heat-wave.pdf.
- K. Parsons: Human thermal environments: the effects of hot, moderate, and cold environments on human health, comfort, and performance (ed. 3rd edition). Crc Press, Taylor and Francis Group, 2014.
- S. Pingle: Occupational Safety and Health in India: Now and the Future, *Industrial Health*, vol. 50, 167-171, https://doi.org/10.2486/indhealth.MS1366, 2012.
- R. Rael: Earth architecture (ed. 1st), vol. UN Doc. E/CN.4/Sub.2/1994/9. Princeton Architectural Press, New York, 2009. Retrieved from https://www.papress.com/html/product.details.dna?isbn=9781568987675.

- SDC: Brick by Brick: the Herculian Task of Cleaning up the Asian Brick Industry, Swiss Agency for Development and Cooperation, 2008. Retrieved from http://www.indiaenvironmentportal.org.in/content/256691/brick-by-brick-the-herculean-task-of-cleaning-up-the-asian-brick-industry/.
- S. Sengupta (3 6 2007): In a New India, an old industry buoys peasants, *The New York Times*. Retrieved from http://www.nytimes.com/2007/06/03/world/asia/03brick.html.
- Ravi S. Srivastava: Bonded Labour in India: its incidence and pattern, International Labour Office, Geneva, Switzerland, 2005. Retrieved from http://www.ilo.org/wcmsp5/groups/public/@ed_norm/@declaration/documents/publication/wcms_081967.pdf.
- UNDP: Climate Change and Labour: Impacts of heat in the workplace – Climate change, workplace environmental conditions, occupational health risks, and productivity – An emerging global challenge to decent work, sustainable development and social equity, Issue Paper, Climate UNDP Vulnerable Forum (CVF) Secretariat: Geneva, Switzerland, 2016.
- UNEP: UNEP/WMO (2011) Integrated Assessment of Black Carbon and Tropospheric Ozone, UNEP/WMO, 2011. Retrieved from https://wedocs.unep.org/rest/bitstreams/12809/retrieve.
- O. Wainwright (8 1 2014): Blood Bricks: How India's urban boom is built on slave labour, *The Guardian*. Retrieved from https://www.theguardian.com/artanddesign/architecture-design-blog/2014/jan/08/blood-bricks-india-urbanisation-human-rights-slave-labour.

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