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Technology is Culture: Building a transdisciplinary team to address community energy and urban revitalization challenges

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Short Abstract

Traditional development models assume that countries of the Global South will undergo an economic trajectory roughly equivalent to that of the Global North. The reality of climate change caused by the burning of fossil fuels raises the prospect that a new model, founded on renewable and sustainable energy will have to be designed. At the same time, rural locations in North, face devastating economic consequences of an industrial model that has left them behind. Our international, transdisciplinary research team, working in Eastern and Southern Africa on sustainable biomass energy and in New Kensington, PA on rural small town renewal, seeks to understand the intersection of community preferences, technological innovation, gender relations and environmental sciences to develop socio/technological interventions. We flip the development model, bringing African expertise to bear on US-based problems and US-based insights to understand sub-culture specific cultural preferences in Kenya. This presentation outlines how we work together, the methods we use to engage in creative problem solving and the unique “kitchen laboratory” used on the Kenyan side to assess cooking energy needs.

Keywords: energy, Eastern and Southern Africa, collaborative research, wood fuels, rural development

Woodfuel, cooking energy, emissions, rural revitalization and architectural reconstruction

Our international research team works on two areas of rural development: wood fuel systems in Eastern and Southern Africa and core small town rural revitalization in Rust Belt Pennsylvania. Both areas of investigation have proven to be complex and solution-resistant. The team we have created under the leadership of Dr. Njenga in Kenya and Dr. Obonyo in the US, utilizes a co-learning, transdisciplinary model to reframe the challenges faced by communities in our regions of interest. Borrowing from global competency theory, we begin our collaboration with an in-depth process of mutual co-learning about the key insights and methodologies of each others’ disciplines. In doing so we focus on core knowledge components, skills acquisition, and careful assessment of the social, cultural and personal identity stakes of each team member. Only when we adequately understand each others’ positions as researchers and human beings, do we then expand our interactions into targeted communities. When interacting with communities, two questions guide our problem framing: what must be retained? And what can be usefully changed?

Wood fuels and Sub-Saharan Africa

Wood fuels, firewood and charcoal, are the most widely used fuels for home use in Sub-Saharan Africa (SSA). According to the World Energy Outlook, in 2013 more than 2.7 billion people— 38% of the world’ s population, relies on the traditional use of solid biomass for cooking, typically using inefficient stoves in poorly ventilated spaces (IEA 2016). In Sub-Saharan Africa, more than 90% of the population relies on firewood and charcoal for cooking and heating (IEA 2006). In Kenya, about 90% of rural households and 7% of urban households, giving an average of 70% of households, use firewood (MoE 2002). Further 82% of urban households and 34% of rural household use charcoal in Kenya (MoE, 2002). Unfortunately about 99% of the charcoal producers use traditional kilns with about 10% efficiency in terms of yield hence wasting a lot of wood (Mutimba and Barasa,

2005, Okello et al., 2001). Women and children travel long distances carrying heavy loads of firewood sourced from natural forests and the loads are as high as above 52kg carried by women of about 55kg (Njenga et al., 2017a). They spend many hours that otherwise would be spent in productive activities and schooling for girl children. Removal of dead wood from natural forests, some of which are main water towers, negatively affect water infiltration, soil erosion and organic matter that forms good seed beds.

Unsustainably produced and inefficiently used wood fuel has several major negative impacts: indoor air pollution, environmental degradation and the demand sourcing such fuels have on user's time . Globally, 4.2 million people die from the effects of wood fuel combustion every year (Lim and Vos, 2012).. The drastic impact of combustion is particularly acute on women, children and the elderly. Promising innovations including those by grassroots communities exist, that could make the woodfuel systems sustainable (Njenga et al., 2017a, Njenga et al., 2017b; Njenga et al., 2013).

Small town revitalization in the rural Rust Belt

New Kensington, PA like many small towns and rural areas in the hearthland of the United States has been economically, culturally and technologically left behind as the country as a whole engaged in large scale social and technological transformation. While it is painful to acknowledge the realities of the living conditions and frustrated aspirations of the inhabitants, understanding the shortcomings of industrialization and modernization in the United States provides critical information for African countries seeking rapid transformation. Dr. Obonyo has been working with a team that includes Penn State students to rebuild the downtown business district of New Kensington. Initially the challenge was posed as one of repairing damaged roofs but it quickly became a more complex venture in which community aspirations, resilience in the face of wide-spread poverty and combating loss of hope became critical to determining how to bring life back to a moribund, isolated rural town.

1. Methods

The methodology must be clearly stated and described in sufficient detail or with sufficient references.

The transdisciplinary process involves the team working together throughout the project cycle. This includes defining the problem, prioritizing interventions, designing the action, implementation, monitoring and evaluation, communication and policy influencing. Our team is comprised of social and natural scientists from global south and north including a gender researcher and post-graduate students. This team works with practitioners who include development agents including those involved in advocacy, policy makers, grassroots women researchers with whom they co-run the kitchen laboratory. Female researchers lead in the mapping of distances travelled and time spent in gathering firewood from natural forests and the weights of firewood that they carry. In the kitchen laboratory, participatory cooking tests are carried out by women and other researchers where functionality, energy use efficiency and concentration of gases and particles from burning fuel are measured. Portable gas and particle measuring equipment's are hung 1.5 metres above and 1 metre to the side of the cooking pot and details of the procedure can be found in Njenga et al., (2017b Figure 1.).



Figure 1. Naomi and Lucy cooking ugali (maize flour meal) while James a PhD student collects data and emission equipment's are hung on the wall, at the kitchen laboratory at Kereita, Kiambu County. Photo by Mary Njenga

Participatory cooking tests are carried out by women in their kitchens and one kitchen about 50km West of Nairobi city and to the South West of Aberdare forest one of the Kenya's water towers is the key kitchen laboratory.

At the Pennsylvania site, a key cultural constraint included deciding what success would look like in a small town at a time when economic progress has been predicated on large scale urbanization. A question that has emerged from the first phase of the Pennsylvania site is equally applicable in rapidly urbanizing Kenya and Tanzania: How can the economic and social benefits of the modern, global world enhance the experience of rural people? Put another way: While many may move to the cities, how do we insure that those who choose to stay in small towns and rural locations are not forgotten and disenfranchised?

2. Results and discussion

In both the East African and Pennsylvania sites, projects have completed their first cycle. In both locations, it has become clear that remedying a practical problem: the use of wood fuels for home heating and cooking, and, putting adequate roofs on business district buildings, were in fact just physical manifestations of larger social issues. Our team was able begin a dialog around community concerns by including local representatives and wood fuel users in the research processes from the initial steps of defining the problem.

In the case of wood fuel users, the co-generated results show that sourcing firewood from natural forests risks women and children's lives from attack by wild animals and injuries from walking through rough terrain

(<https://www.youtube.com/watch?v=QN0oFAMaabo>). Further women lose income that they otherwise earn working as labourers in the farmers and in case of injuries they also are left without firewood and depend on well-wishers to help with this important cooking and heating energy (Njenga et al., 2017a).

Women's involvement in measuring distances and time spent in the forest sourcing firewood and weight of loads they carry has enhanced their awareness on their burden increasing their eagerness to apply innovations that can address their needs. Walking with women to the forest and back home has allowed the researchers from both the global north and south to experience the challenges women face and strengthened the relationships and trust in the team.

The effectiveness of local women's observations and insights has led to the creation of what we call the kitchen laboratory where a range of measurements can be taken in accurate field conditions and users can experiment for themselves with new cooking technologies. At the same time, funding has been secured to begin trailing indoor air pollution reducing devices. Currently at the initial stages, the aim is to determine where and how emissions could be absorbed in ways that do not inhibit existing cooking preferences or require additional labour on the part of women.

In Pennsylvania, repairing roofs led to consideration of broader needs in the community. Lack of a public park prevented residents from considering their town a place where they might chose to engage in leisure. With the help of the participating students and local volunteers, an empty lot was transformed into a park space which in turn makes the town more of a gathering place for residents. Just as in Kenya, access to energy and transportation determines the ability of residents to participate fully and successfully in a meaningful life. Lack of employment, long commutes which require expensive reliable vehicles, all lead to isolation and poverty. As fossil fuels become inevitably more scarce and more expensive, rural inhabitants become more isolated from the rest of the country. The next phase of the project will dig deeper into question, how can economic growth be managed without causing excessive use of climate change inducing, gasoline?

3. Conclusions

Conclusions should include (1) the principles and generalisations inferred from the results, (2) any exceptions to, or problems with these principles and generalisations, (3) theoretical and/or practical implications of the work, and (4) conclusions drawn and recommendations (5) comments on the relevance of the partnership among African and European institutions are welcome (see call for extended abstract for further reference)

Workable partnerships among the natural and social scientists from the global south and north and intended users of the technologies allows co-generation of knowledge and co-innovation towards solving societal

problems. Partnerships work better if there is mutual understanding, mutual respect, mutual trust and mutual learning among scientists from different disciplines, countries and users of the technology. Although societal problems may appear obvious to the affected community their reflections on the implications on livelihoods and the need to develop solutions in critical. Women in Kenya, as users of cooking technologies have local knowledge that is crucial in development of technologies and innovations that answer their needs. The citizens of New Kensington must similarly have their preferences taken seriously. Development and re-development theory has typically presumed that rural and small town inhabitants are motivated by the same economic and cultural norms as those who live in suburbs and cities. What our cross-cultural work is slowly revealing is that this assumption has been made in haste. People who live in rural areas by choice and tradition, have a vested interest in their communities as they currently exist. While they are willing and able to actively participate in the improvement of the technologies and infrastructures of their regions, their preferences and life experiences need to be fully integrated into any intervention. This reality and the means by which that integration happens has been enhanced on our side as a team because of the transdisciplinary methods we employ to encourage cross-fertilization of ideas.

4. References

IEA, World Energy Outlook. Paris, France: IEA/OECD, 2016.

IEA, World Energy Outlook.. IEA/OECD, Paris, France, p. 596. 2006

Ministry of Energy, (MoE), Government of Kenya, Study on Kenya's Energy Demand, Supply and Policy Strategy for Households, Small scale Industries and Service Establishments, Final Report, May, KAMFOR Company Ltd., September, 2002.

Njenga, M., Mendum, R., Gitau, J., Iiyama, M., Jamnadass, R., Watson, C., Trees on farms could satisfy household's firewood needs. Miti. The Tree Business Magazine for Africa. 33, 20-23, 2017a.

Njenga, M., Mahmoud, Y., Mendum, R., Iiyama, M., Jamnadass, R., Roing de Nowina, K., Sundberg. C., Quality of charcoal produced using micro gasification and how the new cook stove works in rural Kenya. Environ Research Letters, 12 (9).2017b.

Njenga. M., Yonemitsu, A., Karanja, N., Iiyama, M., Kithinji, J., Dubbeling M., Sundberg, C and Jamnadass, R. 2013. Implications of charcoal briquette produced by local communities on livelihoods and environment in Nairobi, Kenya. International Journal of Renewable Energy Development (IJRED). 2 (1) 19-29. Available online. <http://www.ijred.com/index.php/ijred/article/view/88/pdf>. ISSN 2252-4940. 2013.

Mutimba, S., Barasa. M., National Charcoal Survey: Summary Report. Exploring the Potential for a Sustainable Charcoal Industry in Kenya. Energy for Sustainable Development Africa (ESDA), 2005.

Okello, B.D., O'Connor T.G., Young, T.P. Growth, biomass estimates, and charcoal production of *Acacia drepanolobiu* in Laikipia, Kenya. Forest Ecol. Manage. 142:143-153. (2001).

Lim, S.S. Vos, T., A Comparative Risk Assessment of Burden of Disease and Injury 729 Attributable to 67 Risk Factors and Risk Factor Clusters in 21 Regions, 1990–2010: A Systematic.730 Analysis for the Global Burden of Disease Study 2010. Lancet: 380, 2224–60. 2012