



Unstable and broken clay pot stove in Hòa An.
Image: A. Bosold.

Carbon, cookstoves, and kitchens: case studies of fuelwood use and the potential for ethanol substitutability in rural India, Vietnam, and Tanzania

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Ethanol-fueled cooking stove.
Image: PGI.

Introduction

Forests supply the primary source of domestic cooking fuel in many rural communities worldwide (Fig. 1). Unsustainable levels of fuelwood consumption, however, contribute not only to local forest degradation but also to global climate change through the release of black carbon and carbon dioxide into the atmosphere. Moreover, as a driver of indoor air pollution (IAP), it also negatively affects human health (Fig 2). IAP linked to cooking smoke is among the leading causes of preventable respiratory disease, and negatively impacts women and children through disproportionate and repeated exposure (WHO, 2014; Torres-Duque *et. al* 2008). As an alternative to fuelwood and charcoal, a combined approach using specially designed ethanol-fueled stoves has been used successfully on an experimental basis in relief camps of Ethiopia and Haiti, where fuel shortage directly contributes to food insecurity, gender-based violence, and other social problems (O’Brien and Murren 2005). Similarly, in Brazil, a country with existing commercial ethanol markets, exploratory studies about community-based micro-distillation show promise for the possibility of ethanol fuel self-sufficiency (Couto 2007).

One recurring question throughout these experiments remains: *Which socio-cultural factors are likely to shape household-level acceptance or rejection of a proposed transition from wood to ethanol as a source of domestic energy, and why?* In partnership with the international development NGO Project Gaia Inc (PGI), we conducted a series of pilot studies to gain insight into this question. Research methods included literature review and international fieldwork conducted in three countries: Vietnam, India, and Tanzania (Fig. 3). Field methods in Vietnam (4 weeks in 2012-2013) and India (4 weeks in 2013) emphasized participatory rural appraisal exercises and ethnographic methods such as participant-observation, participatory mapping, focus group discussions, and in-depth household interviews with women (lasting approx. 1-2 hours each, on average). In Tanzania, PGI institutional partners conducted similar exercises from Sept. 2014-June 2015. Stove demonstrations and kitchen performance tests (KPTs) were conducted at each site, where all household meals were prepared on the ethanol stove over a 24-hour minimum test period. Fieldwork was supported by local assistants and translators at each location.

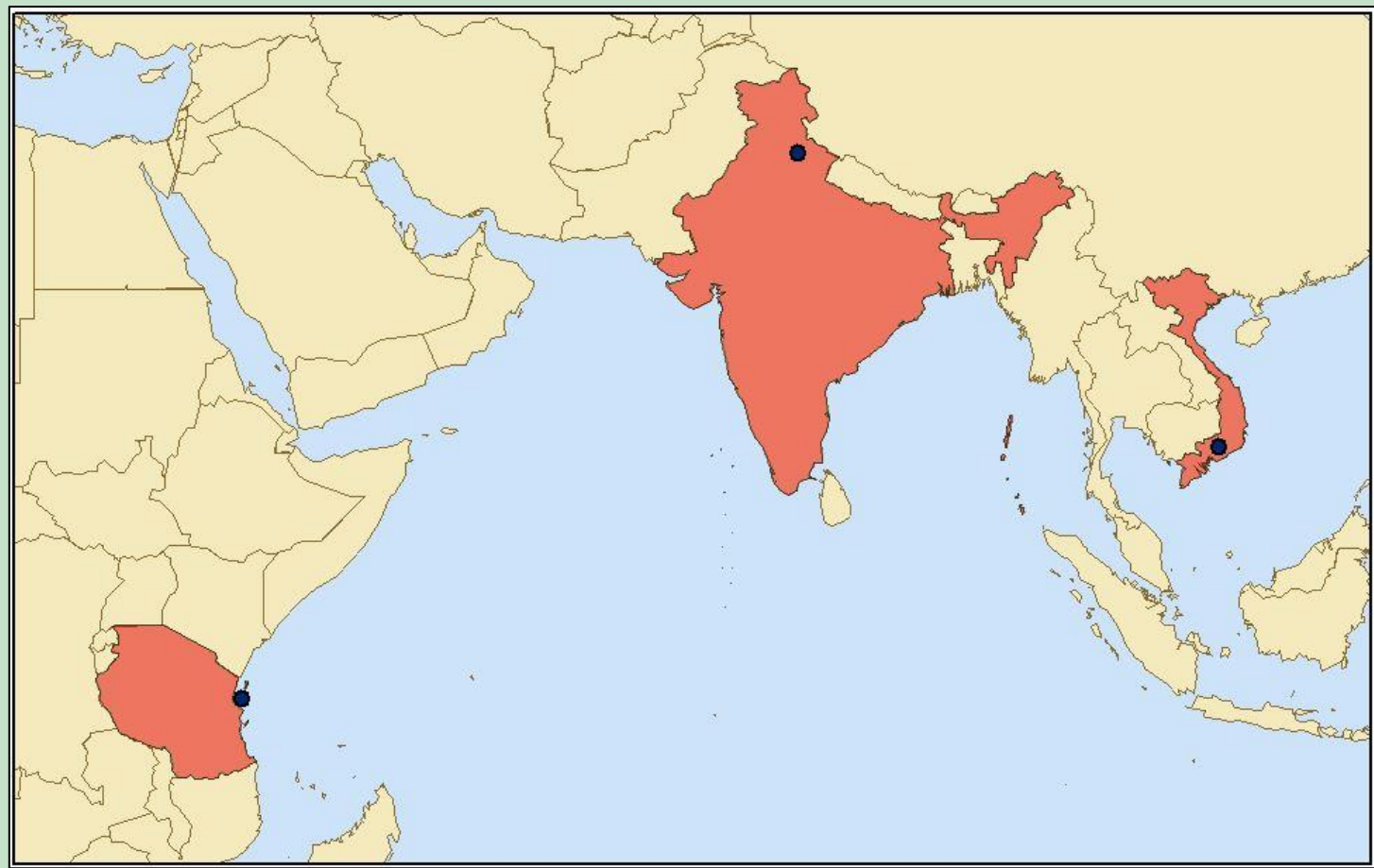


Fig. 3: Study sites. ArcGIS: Mapping Our World. Map: Q. Heist.

Theoretical Framework

Our analytical framework draws broadly from work in feminist geography, including feminist political ecology and gender and development (e.g., Rocheleau *et. al* 1996, Domosh and Seager 2001, Momsen 2004, Oberhauser and Johnston-Anumomwo 2015), sustainable development (e.g., WCED 1987, Baker 2007, and Sachs 2015), and asset-based models in development geography relating to sustainable rural livelihoods, social capital, elite capture, and social exclusion (e.g., Woolcock and Narayan 1999, DFID 1999, Bebbington, 1999, and Sen 1999). We employ a feminist political ecology approach in recognition of the complex and interrelated dimensions of the IAP issue and influence of gender on the division of labor patterns observed within households, as well as the concomitant group dynamics (e.g. in terms of race, ethnicity, caste, and class dimensions) that shape power and control over the household- and community-level decision-making processes about domestic fuel and related cooking technologies. In particular, we follow Rocheleau *et. al* in suggesting that when it comes to IAP and cooking technologies, gender functions “as a critical variable in shaping resource access and control, interacting with class, caste, race, culture, and ethnicity to shape processes of ecological change, the struggle of men and women to sustain ecologically viable livelihoods, and the prospects of any community for ‘sustainable development’” (1996: 4).

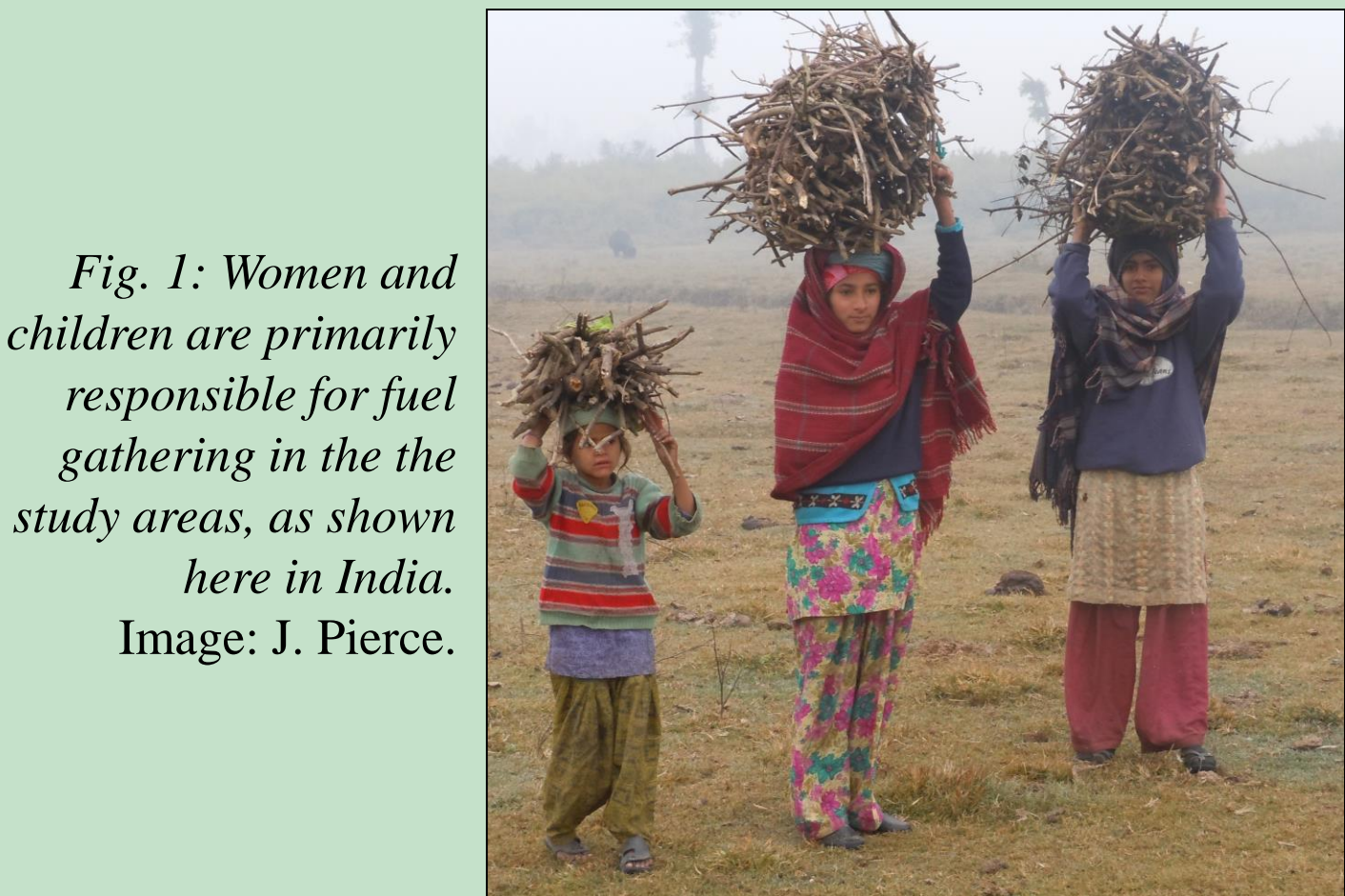


Fig. 1: Women and children are primarily responsible for fuel gathering in the study areas, as shown here in India.
Image: J. Pierce.

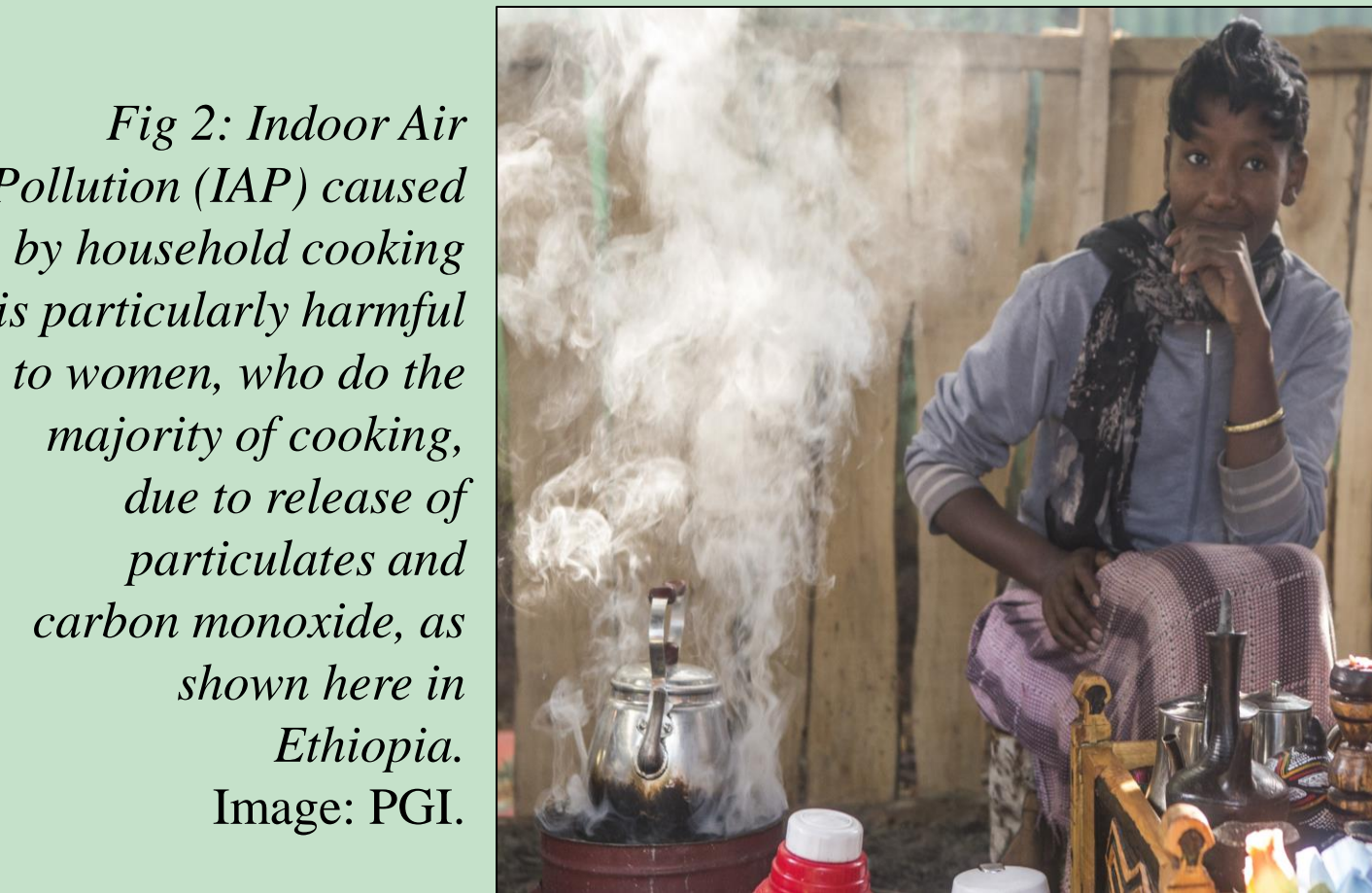


Fig 2: Indoor Air Pollution (IAP) caused by household cooking is particularly harmful to women, who do the majority of cooking, due to release of particulates and carbon monoxide, as shown here in Ethiopia.
Image: PGI.

Hòa An Village (Xeo Trâm Hamlet), Vietnam

(8 participating households in focus groups, questionnaire interviews, and KPTs, representing both biogas and fuelwood users)

User Preferences

- Desire for alternatives; Recognition that the major air quality problems come from wood stove use and drastically affect health.
- Concerns about fuel and stove cost: Wood and biogas perceived as “free” resources, but are limited by availability and access.
- Ethanol stove model offers convenience and attractive appearance; Compared to fuelwood and existing alternative in the form of VACB (pig-duck-fishpond biogas model), ethanol is more hygienic and easier to use. Because VACB model is also very labor and capital intensive for women, poorer families seek long-term alternatives and appreciate community aspects.
- Users were enthusiastic about stoves due to their ‘modern’ look and feel. Some considered it to be a positive status symbol.

Perceived Environmental Impacts

- Fuelwood shortages and IAP are problems that can be addressed by this model if sufficient feedstock can be secured on a local level.
- Enhanced opportunity for local resource utilization identified by participants: Feedstocks in the form of rice husks, sugarcane waste (bagasse/ molasses), water hyacinth are viewed as “waste” and readily available for use in distillation.

Highlighted Socio-Cultural Issues

- For study participants, women’s consultation with husbands about fuel choices would remain in place, but empowerment opportunities were perceived in terms of opportunities for entrepreneurship and participation in micro-distillery operations.
- Participants associated the micro-distillery and ethanol-fuel model with development opportunities and intensification of existing social networks, but were unsure if prevailing norms would enable spaces for women to maintain leadership positions in this arena.
- Pre-existing traditions of home-based rice wine production offered a form of cultural support for the proposed micro-distillery model.

Gaindikhatta Village (Uttarakhand) India

(25 questionnaire interviews, 7 focus groups, and 9 household KPTs representing socioeconomically, culturally, and spatially distinct sub-communities)

User Preferences

- Stoves and flame size were reported to be too small and not hot enough for convenience.
- Resistance to change: Participants enjoyed the new stove, but noted that absence of wood affected taste.
- Imperfect substitutability: Fuelwood stoves are valued for heat and as social space (these needs are not met by the ethanol fuel stove).

Perceived Environmental Impacts

- Fuelwood consumption may not be significantly reduced by introduction of alternate stove, as cooking fires serve multiple purposes.
- Resource utilization issues: Agricultural by-products are not viewed as waste under current system, which is integrated with livestock.

Highlighted Socio-Cultural Issues

- Household-level power structure positions senior males of the household (not stove users) as likely decision-makers for any proposed change.
- Religious beliefs within Muslim households in the study site prohibit alcohol consumption, leading to only tentative approval of ethanol fuel.
- Women stove users across groups concerned about potential for a micro-distillery to lead to ‘misbehavior’ and alcohol abuse among men.
- Concerns about land availability in context of insecure land rights/land shortage (Fig. 2) and location of micro-distillery.
- Dominance hierarchies based on class, caste, ethnicity, and gender constrain ability to obtain and use alternate fuels (Fig. 4). Concerns that introduction of a micro-distillery and new employment opportunities may not advance social equity goals (resistance to power-sharing/distribution of benefits).

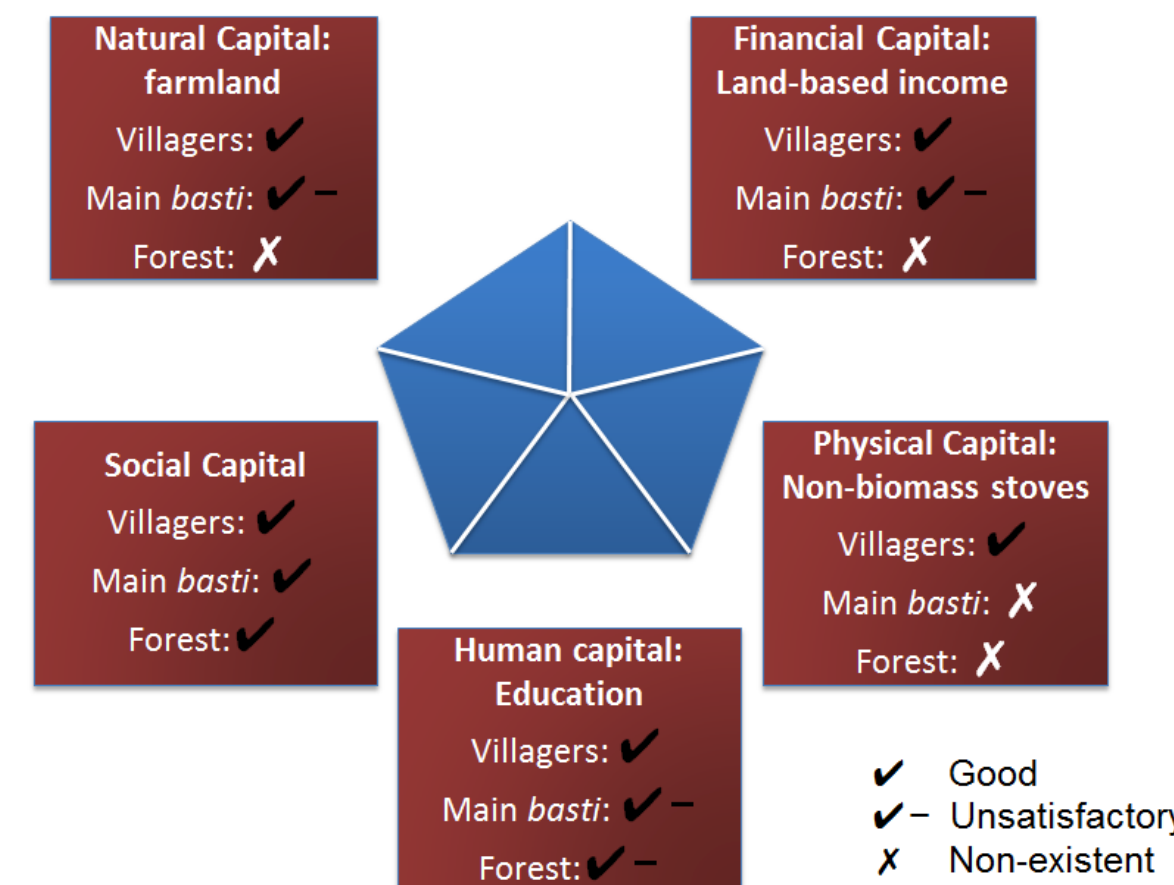


Fig 4: Distribution of livelihood assets in the study site. Further analysis of these factors can be undertaken to examine priorities within and between gender-based, economically stratified and different ethnic groups.
Figure: J. Pierce

Stone Town (Zanzibar), Tanzania

(122 questionnaires and 6-week KPTs, with weekly interviews with participating households from four districts of Zanzibar)

User Preferences

- Women reported enhanced safety for children who are in cooking area, reduced smoke exposure.
- Fuel was reported to be consumed too fast, and the price of fuel was seen to be too high.
- Women chose to use their ethanol stoves in addition to (not instead of) their existing stove; Ethanol stove was seen as status symbol.

Perceived Environmental Impacts

- Forest resources are being depleted rapidly, as wood collection and charcoal production/sale are important livelihood strategies and sources of income-generation and employment (women collect fuelwood for domestic use, men primarily make and sell charcoal).
- Indoor air pollution was reduced with use of ethanol stove, though continued reliance on other stoves was observed and reported.
- Resource utilization opportunity in the form of unused molasses from sugar factory, which is currently viewed as a pollutant.

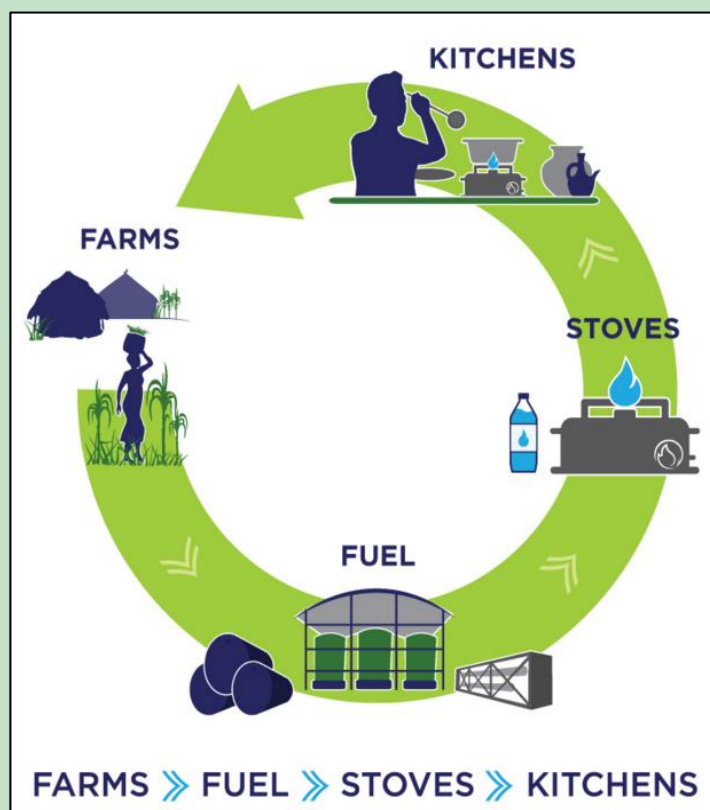
Highlighted Socio-Cultural Issues

- Commercialization challenges linked to restrictions on alcohol (imported alcohol is taxed as beverage alcohol regardless of use).
- A successful carbon credit program is not established for this model, despite institutional partner efforts to participate.
- While feedstocks are readily available, infrastructure for distribution and distillation facilities must be established (Fig 5).
- Unlike in India, religious traditions in the study did not emerge as an area for cultural incompatibility.



Fig 5. Small micro-distilleries like this one in Brazil, allow for the creation of ethanol from local feed stocks and have the ability to empower a community if implemented correctly.
Image: PGI.

Fig 6. Cycle of stove integration and micro-distillery into a community. Agricultural waste is converted into alcohol fuel (ethanol), which generates employment as well as a sustainable source of efficient and safe cooking fuel.
Image: PGI.



Discussion and Recommendations

Although fuelwood dependence has been offset by the availability of subsidized commercially-available fuels such as kerosene or liquid petroleum gas (LPG), the need persists for a clean, efficient, locally available, and sustainable fuel source for use in household cooking. While we recognize the potential for women’s empowerment associated with reduced labor demands in the form of fuelwood collection and opportunities for new forms of status (through, for example, increased participation in education, labor markets, and self-defined arenas for change), we recommend that advocates of sustainable development and ethanol-based domestic fuel technologies critically consider the following issues prior to any proposed related intervention: (1) the prevailing cultural, socio-economic, and environmental aspects of micro-distillation and local ethanol use, particularly for communities in which alcoholism and illegal spirit manufacture are already overriding concerns; (2) the potential for resource capture by local elites, including new resources generated such as employment opportunities, capital, and status/power; (3) the potential to create new forms of gender-based power hierarchy by transferring the responsibility of fuel production from the household to the level of community; and (4) the socio-spatial dimensions of land availability (including tenurial issues), agricultural production systems and related decision-making processes, and cross-scale market transactions related to the sale of micro-distillery produced ethanol fuel.

At the same time, the enthusiastic reactions of study participants to the idea of this closed-loop, environmentally and socially sustainable model for domestic fuel production and self-sufficiency (Fig. 6) leave us cautiously optimistic. Future studies in the four areas outlined above can contribute to furthering knowledge about and support for the intended pathways to sustainable and equitable development envisioned by ethanol fuel advocates. In addition, further agro-ecological and technical studies to enable ethanol production from biomass in the form of noxious weeds and invasive plants (such as water hyacinth) should be prioritized. The possibility for partnerships between community-based micro-distilleries and local industries producing feedstock-suitable waste (e.g., sugar factories, as suggested by UNIDO 2015) should also be explored.

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Acknowledgments

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