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# The revolution from the kitchen: Social processes of the removal of traditional cookstoves in Himachal Pradesh, India

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ABSTRACT

Despite decades of effort, widespread adoption and long-term use of improved cookstoves in developing countries remain hard to achieve. Conventional energy transition models emphasize households' socio-economic improvement as the most important driver of energy transition. However, previous work has shown households' continued use of old cookstoves or fuels even when adopting new technologies. Through a case study in India, this paper highlights the socio-political processes of the permanent removal of the traditional chulha cookstove. Newly available liquefied petroleum gas stoves and improved biomass stoves, thought to be substitutes for chulha, lead to different adoption pathways for lower and higher caste households. Lower caste households seem to remove chulha more readily because of sensitivity to chulha's heavy smoke that pollutes their utensils, kitchen, and clothes. We posit that by adopting cleaner stoves and removing traditional ones, the marginalized can disassociate themselves from practices that perpetuate their social stigma.

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## Introduction

Since the 1970s, development and conservation groups have disseminated millions of improved cooking devices and fuel to address a variety of environmental, health, and livelihood issues in the developing world with varying degrees of success. Many of the early interventions were triggered by the perceived fuelwood crisis and deforestation in the 1970s (Eckholm, 1975; FAO, 1985). As later studies show that agricultural expansion and commercial timber harvesting contribute more to deforestation (Agrawal, 1986; Leach and Mearns, 1988), the focus of later interventions has shifted to development and health improvement as a result of growing evidence of impact of energy poverty and indoor air pollution. Many scholars have continued to argue that access to more commercialized, cleaner fuels and devices, such as charcoal, kerosene, or liquefied petroleum gas (LPG) stove, critically contributes to human and economic development (Bates, 2002; Pachauri et al., 2011; Smith, 1994). Globally, 4.3 million premature deaths each year are attributable to household air pollution from inefficient burning of solid biomass (WHO, 2014), which is the third most important mortality risk factor for Indians and fourth biggest globally (IHME, 2013a, 2013b). The concern of climate change associated with black carbon, commonly found in the soot resulting from incomplete combustion of biomass, has ignited the newest round of enthusiasm in household energy (Bond and Sun, 2005; Grieshop et al., 2011).

The literature on why cooks adopt or reject improved cookstoves abounds (e.g. Bailis et al., 2009; Barnes et al., 1994; Lewis and Pattanayak, 2012; Mobarak et al., 2012; Ramirez et al., 2014); but falls short on what factors incentivize households to discard traditional stoves. The general assumption is households will automatically abandon their rudimentary stoves and fuels when they switch to high quality modern ones, as their income goes up—constituting the so-called "energy ladder" model (Hiemstra-van der Horst and Hovorka, 2008; Hosier and Kipondya, 1993). Despite decades of efforts, many empirical studies have found that widespread adoption and sustained use of improved biomass cookstoves or modern fuels are hard to achieve (e.g. Agrawal, 1986; Gill, 1987; Hanna et al., 2012; Mobarak et al., 2012; Puzzolo et al., 2013; Ruiz-Mercado et al., 2011). Masera et al. (2000) find that households often revert to their traditional stoves or use them together with improved biomass, electrical, or LPG cookstoves in order to meet users' diverse food and fuel preparation practices—a phenomenon referred to as "fuel stacking." They and other studies suggest a non-linear multiple-stove model that accounts for cultural, economic, and health factors that shape people's decisions (e.g. Heltberg, 2005; Ruiz-Mercado et al., 2013). While LPG or hyper-efficient forced draft stove powered by an engine is recommended as key to meet health standards, the continuous use of smoky stoves can seriously undermine the intended health improvement of large-scale improved cookstove distribution programs (Hanna et al., 2012; Johnson and Chiang, in review). Johnson and Chiang (in review) report that even one hour of

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cooking on three-stone open fire in a week exceeds the World Health Organization's (WHO) annual guideline or the less stringent interim 1 target for PM exposure. How to deal with stove stacking is of heated debate among cookstove practitioners and scholars, especially given the current emphasis on the health objective of many ICS policies and programs (Gordon and Hyman, 2012; Washplus, 2013). This paper attempts to offer greater understanding of how removal might happen.

Based on household surveys and semi-structured interviews carried out in the mountain communities living in the Kullu district in the state of Himachal Pradesh, India, we trace the social processes of the permanent removal of the traditional cookstove made of mud called *chulha*. We begin by introducing our case study field site and methodology. We then outline the debate in fuel transition theories and discuss our contribution to it by drawing from anthropological and historical studies of development and innovation diffusion, with a focus on the role of underlying cultural and political dynamics that propels change (e.g. Pigg, 1992; Rogers, 1995). Specifically in the case of Hindu societies in India, we extend the theoretical framing to explore how two interrelated social forces—the caste system and the drive for modernity—shape the kitchen and the culture of food and cooking. In discussing our results, we center the analysis on the kitchen space and underline its key connections with the ecology and agents of the modern world: the local stove artisans and markets, the development and conservation organizations, the quasi-public gas distribution agency, etc. To trace the fate of the traditional stove, we first document the process of the dissemination and adoption of the clean-burning LPG cookstoves promoted by a local non-government organization (NGO), and then the penetration of another type of fully commercialized improved biomass cookstove called a "tandoor."

As an attempt to understand the removal of traditional stoves, the paper highlights that access to alternative fuels and/or stoves and social delineation are important factors, among other things. Lower caste households seem to be abandoning the traditional stoves more readily than higher caste households and we identify a set of triggers and drivers for such changes. We posit that the lower castes, tired of the heavy smoke that blackens their kitchen and perpetuates the religious stigma of them being impure, attempt to disassociate themselves from practices that are both literally and symbolically dirty, in favor of practices that are both clean and modern. The case study suggests that the adoption of a new technology somewhat follows the conventional scheme where economic and social elites lead diffusion. However, it proposes that the traditionally marginalized might lead the disadoption of the old, fueled by their desire for cleanliness to remove social stigma. Finally, we discuss the ways in which insights into cultural and political context provided by rigorous qualitative case study can inform our thinking about interventions to accelerate the transition to clean energy services and what constitutes aspirational demand.

## Research site and method

The state of Himachal Pradesh belongs to the Western zone of the Himalayas, the world's youngest mountain chain (Alam, 2008). The rugged landscape is replete with ridges, valleys, and folds, which historically has given rise to isolated pockets of societies (Berreman, 1963). Ninety percent of Himachal's 6.8 million residents are rural (Census of India, 2011). Its per capita income is 82 611 rupees (1300 USD), above the national average of 60 972 rupees (950 USD) (Government of India, 2013). The study took place in the Kullu district, where scheduled castes (SCs) and tribes (STs) account for 32% of the population—formerly untouchables in India (Census of India, 2011). The rest are officially categorized as other backward class (OBC) and forward class (FC) and are referred to as other castes (OCs) in this paper. The Rajput caste makes up the majority of the non-SC population (Berkes et al., 1998). Sarkar (2013) shows that LPG users increased from 10% of those surveyed in 2002 to 50% (n = 220) in Kullu district in 2012. The state has achieved 99% electrification at the village level in 1989 given its abundant hydropower resources, but the supply in most places is rather unreliable (Rahi et al., 2008).

From June to August 2013, the lead author conducted fieldwork in collaboration with a local, community-based organization called Jagriti ("awakening" in Hindi) based in Kullu town, the capital of the district. Jagriti's main mission is to empower poor rural hill women, living in Lag and Gadsa Valley northwest and southeast of Kullu town (Jagriti, 2014a). Its activities include the promotion of drudgery-reducing and energy efficient devices and small-scale production and marketing of non-timber forest products within the women's saving and credit groups (WSCGs), created and supported by Jagriti. The lead author participated in field visits and meetings with stove manufacturers organized by Jagriti's staff and interviewed managers in gas agencies and stove manufacturers/vendors in the area. She accompanied a Jagriti enumerator for 43 household surveys, conducted another 21 semi-structured interviews,[1] three focus group discussions with 19 people in total, and participant observation in 11 villages in Lag and Gadsa Valley.[2] Two male interpreters assisted in the fieldwork, translating a combination of the local language Kullui and Hindi into English. The household surveys were part of a larger study to measure gender and livelihood impacts of LPG use by Jagriti's WSCG members, in partnership with the Global Alliance for Clean Cookstoves and Practical Action. This study surveyed 148 LPG users and 52 non-LPG users and is herein referred as Jagriti (2014b). The survey questions included basic information such as demographics, sources of livelihoods, the suite of cookstoves owned, year and price of purchase, firewood use, cook's experience with the LPG, etc. The survey consisted of 56% SCs and 46% OCs. The survey data illuminate trends of chulha retention/removal. We contextualize these data using our rich qualitative evidence and engage in social theories to seek deeper explanations of underlying drivers.

## Theoretical framing

### *From the linear "energy ladder" to the multiple stove model*

Our objective is to examine the social processes underlying the removal of the chulha. What were the pivotal moments for such decisions to be made? Why were SC households more likely to reject the older technology than the higher castes? Is there a set of situational factors that trigger removal, or are there certain household characteristics that we can identify? Through both statistical and qualitative evidence, we hope to bring out the complexities, nuances, and occasionally conflicting narratives that more closely reflect lived realities of these rural communities.

The decades of history of ICS dissemination as a response to changing global concerns of natural resources, public health, and most recently climate, speak to the complexity of both defining the problem and designing solutions to it. In this paper, we focus the discussion in the context of energy transition in developing countries. The puzzle, after decades of attempts, is that households' acceptance of the new does not mean the rejection of the old.

The debate over what determines household fuel choices and the transition over time has seen two main phases of development. Early theories of household cooking patterns in developing economies focus on the "energy ladder" model (Leach, 1992). The model is derived from empirical data suggesting the correlation between the increase in urban households' income and the uptake of modern cooking fuels and devices (Masera et al., 2000). Sathaye and Tyler (1991) show that

[1] Many of these semi-structured interviews were conducted in households with more than 1 family member present, often with husband and wife.

[2] Names of informants are made anonymous unless they requested otherwise, adhering to the study's institutional review board agreement.

as the opportunity cost of a woman's time to collect firewood goes up, she is more likely to switch to modern and convenient fuel. "The energy transition is driven," concludes Leach (1992, p.118), "not by an emerging desire for modern fuels so much as by socio-economic changes." The changes require not just increased income but also improvement in reliability and accessibility of the fuel distribution system (Leach, 1992; Pachauri and Spreng, 2004). Essentially, the model assumes "a linear, unidirectional, or 'natural' process" from one end of the energy ladder to the other, driven by household income (Masera et al., 2000).

Given evidence documenting multiple-fuel use patterns in rural and urban households (e.g. Fitzgerald et al., 1990; Hosier and Kipondya, 1993; Sinton et al., 2004), Masera et al. (2000) propose a new model based on multiple cooking strategies. They first point out the problems of applying the linear fuel switching model in rural areas, where households normally collect their own fuelwood with no monetary cost; livelihoods are primarily subsistence; access to modern fuels can be severely constrained; and local cultural and dietary preferences favor traditional stoves and fuels. From their longitudinal studies in a Mexican village, they find that LPG does not fully substitute firewood and users switch back and forth between the two. The multiple fuel strategy assists families in maximizing fuel security and enjoying the benefits of each. Many users report that LPG is inadequate for some traditional cooking tasks. Multiple fuel users tend to have higher energy expenditure than fuelwood-only users; therefore, one cannot assume that households choose fuel to minimize expenditure. Culturally, the "status symbol" effect and modernization brought by the purchase of a LPG stove also drive adoption. The authors also observe that while family income improves, investments in health do not necessarily increase. This might be because households often ignore the kitchen space, especially its ventilation, when they invest in maintenance and upgrade. Other studies have reached similar conclusions when assessing major drivers of ICS adoption. Factors like fuel savings, convenience, cooking time, compatibility with local cooking practices, status, household location, income, and education level have all been found to play a role to varying degrees, while concern for pollution and health is typically a lower priority (e.g. Lewis and Pattanayak, 2012; Mobarak et al., 2012; Puzzolo et al., 2013).

Overwhelmingly, the focus in the field has been on what drives the diffusion of new technologies, but little attention is given to what kicks out the old. Improved and modern stoves often fail to meet households' dietary and religious preferences, which have coevolved with the use of traditional hearths (Crewe, 1997; Gill, 1987). Current debate in the cookstove community highlights the importance of sustained use and displacement of traditional stoves beyond acquisition, but conditions under which people abandon traditional stoves remain elusive (Shankar et al., 2014). As we will show below using a combination of survey and ethnographic research techniques, existing theories help explain a great deal of the changes going on in kitchens. But we need a better picture of household decision-making and, particularly, the ways in which people modify their dietary and religious practices to adapt to new and reject old technologies.

To understand the shifts in these practices, one needs to look more closely at cultural factors that promote the uptake of a new technology as well as giving up an old way of life (e.g. Sovacool, 2014). Historians, sociologists, and anthropologists who study adoption–diffusion of innovations—a technology, an idea, a policy, or knowledge—can offer illuminating processual details, often highlighting institutional and personal agents, particularly elites and minorities, influences of social values and networks, and increasingly exogenous mechanisms (Cortada, 2013; Kemp and Volpi, 2008; Rogers, 1995; Ruttan, 1996).

These social histories of diffusion and adoption of novel and especially aspirational products suggest a tendency of movement from the elites to the commoners over a long horizon of time. Sugar, according to Mintz (1985), was an exotic luxury among the European aristocrats for centuries until sugar plantations in overseas colonies were developed and supply soared. Thomas Edison built his first utility plants near the mansions of J. P. Morgan and the Vanderbilts, where electricity was first used for interior lighting (Nye, 1992). The rich and powerful are easy allies of the innovators to serve as early adopters, whose lifestyle brews aspiration for the masses. In fact, the Global Alliance for Clean Cookstoves, which aims to reach 100 million households with clean cookstoves by 2020, decides in its initial phase to focus on consumer segments at middle income levels as well as populations with humanitarian aid needs who are likely to be early adopters (GACC, 2012). As the commodity and technology become more available, the craving for sensational and indeed electrifying experiences dims down and their social meanings change (Nye, 1992).

This is the case with how LPG has spread since it was first introduced by the local NGO in Himachal Pradesh, which we will shortly detail. However, the opposite process seems to dominate the removal of the traditional stoves. Schrag (2000) tells the story of how American cities came to abandon streetcars in the 1970s not because buses were newer, faster, or more efficient. In some cases, the opposite was true. Rather, over time, transit companies and municipal politicians supported "the bus as a means to rewrite old rules" (p. 52). Street railway companies had operated as monopolies and were seen as "greedy, dangerous menaces" (p. 61). Therefore, the spread of novel products in place of old ones does not necessarily depend on the technological superiority of the new, but rather as a result of political struggles between proponents of different products. Our study identifies a situation in which non-elites more readily reject the traditional technology than elites, who are more often considered the early adopters of innovation. To explain this, we expand the discussion in diffusion studies by drawing on the idea of cleanliness and social identity in anthropology and development studies. This is particularly relevant to the caste system in Hindu societies but also goes beyond the sub-continent.

### *Caste, modernity, and the kitchen*

The caste (*jatis*) system in India is a deeply rooted and complex social/religious system centered around the dichotomy between purity and pollution (Dumont 1980). We focus here on the aspects of the system that may help explain the motivations and agencies exercised by the people for the changes they make in their kitchen and life. The present day caste system evolves from the earlier construct of *varna*, in which four *varnas* (social classes, or colors) underpin the Hindu society (Gupta, 1980). The Rajputs of North and Central India belonged to the *varna* of Kashatriya, or the emperors and warriors, in comparison to the *varna* of Brahmas, or the priests—both *varnas* of the highest status (Unnithan-Kumar, 1997). The untouchables, or the Dalits, are considered to be too low to be included in the *varna* system. The constitution of the newly independent India abolished untouchability and recognized the Dalits as the scheduled castes in official terms (Banerjee and Knight, 1985). In Dumont (1980) classic writing *Homo Hierarchicus*, he defines castes as hereditary and hierarchical groups that maintain separation and interdependence principally based on the idea of purity versus pollution. "It is the specialization in impure tasks, in practice or in theory, which leads to the attribution of a massive and permanent impurity to some categories of people" (p. 47). There are two kinds of impurity: temporary, during events like funeral and birth, when the closest relatives become "untouchable" by contacting the dead and blood; and permanent, when a person or a group of people specialize in tasks that can be exposed to impurity, such as a funeral priest.

Others critique Dumont for emphasizing the Brahmin-centric view of the Hindu hierarchy while the Brahmins and Kshatriyas could just exhibit more centrality in relation to other varnas, instead of being superior (Raheja, 1988). By stressing the hierarchical structure, Dumont also misses dynamics of opposition from those at the bottom (Derné, 1990). Still, Dumont's conception of how the parts make up the whole in South Asian society with certain organizing principles (Appadurai, 1988) is still a useful framework for the current paper.

Dumont (1980) also demonstrates that cooking and eating food are crucial processes and the kitchen a critical space under the domain of purity and pollution. The principles of separation manifest through both physical and indirect contact with the impure. Among various intermediaries of contact, eating food is an act extremely vulnerable to internal pollution. The kitchen becomes the most vulnerable place in which impurity can fall into the food and pollute the eater. People also believe that some spiritual beings reside in the kitchen. In Kullu, the higher castes, primarily the Rajputs, never eat food made by the lower castes. Rajputs rarely enter SCs' houses, and SCs are forbidden to enter the Rajputs'. Houses in this area usually have three stories: the ground floor for the cow, a first floor, and sometimes an attic. The attic is also viewed as a holy place where some local gods live. In a few cases, the kitchen is in the attic. A menstruating woman, either of high or low caste, is considered impure and forbidden to enter the kitchen usually for three days to a week.

The idea of cleanliness and social ascendency is also discussed in other contexts. For example, Orlove (1998) shows how indigenous Peruvians' and more urban mestizos' relative approximation to dirt and earthly objects reinforces these two groups' racial identities. The mestizos often view the indigenous as dirty lower class people because of their more direct contact with dirt, their use of clay pots, wearing straw shoes, for example. But the distinction is fluid in that a person can be more or less indigenous by how close their lives are tied to the village, agriculture, earthenware, and dirt. This distinction then serves as an impetus for civilizing the indigenous as part of the modern nation building process.

In another vein, anthropologist Pigg (1992) argues that the project of development ("modernization", "empowerment") creates the distinction between the rural village Nepalese and the urban metropolitan Nepalese in a profoundly rural nation. The villagers become associated with the quintessential act of carrying someone else's loads—the more often you carry, the more rural, of lower status you are. The villagers, however, do not necessarily see themselves the same way the urban elites see them. "They are cosmopolitan villagers, and they claim their place on the side of bikās (development) (p. 510)." Thus,

> "Local people are simultaneously caught up in two social orders: One is the local world of hierarchies of age, gender, and caste or ethnic group; of relations of patronage; of exclusion; and of exchange. The other is the national society, with its centers and peripheries of development. Each provides people with a way of framing local identity…(p. 510)."

Like the notions of purity, indigenousness, and rurality, caste is neither static nor uncontested. Social anthropologist Srinivas (1952) first used the term Sanskritization to refer to the upward movement in the caste hierarchy, which also has particular bearing on the kitchen. Lower castes, by adopting the behaviors, customs, ideologies, and Sanskritic rituals of especially the highest Brahminic varna (such as adopting vegetarianism), are able to establish higher social status within the local system. This process is normally preconditioned by either "an improvement in the economic or political position of the group concerned or a higher collective self-consciousness resulting from contact with a source of the 'Great Tradition' of Hinduism such as a pilgrim center" (p. 57). While Sanskritization has happened throughout the subcontinent over the past 2500 years, the British push for secularization and westernization adds another source of societal aspiration (Srinivas, 1989). However, others have contested Sanskritization on many grounds, particularly on its faulty dichotomy of the Sanskritic and non-Sanskritic and its oversimplification of castes relations (Carroll, 1977; Staal, 1963). In studying communities in Pokhara, the second largest city in Nepal, Amar Bahadur (2008) forms an alternative explanation to the ongoing socio-cultural transformations among the Dalits. He sees two relevant processes being staged: 1) reformation—"adoption of certain practices which belonged to the higher castes earlier such as fasting, daily worship…and rejection of the practices which they thought were non-Sanskritic and polluting such as pig raising, alcoholism, traditional occupations etc." and 2) assertion, where Dalits adopt certain practices as their rights, i.e., temple entrance and worship. These socio-cultural changes seem to be influenced by modern values and disapproval of the caste system and the privileges of higher castes.

Here in Kullu, we argue that the lower castes' desire to have a clean kitchen does not necessarily originate from their attempt to become more Sanskritized. They could, however, be in a messy state of formulating new identities amidst a fast changing and overlapping political-economic landscape. By rejecting what they perceive as polluting practices and adopting what they see as modern, the lower castes are paving a hybrid pathway for social repositioning, and the kitchen becomes a venue of manifestation. Modernization certainly has effects on the higher castes too, which we argue exhibits more so through the adoption of modern technologies, rather than the rejection of the old.

## The revolution from the kitchen

As has been documented elsewhere in India (Pachauri and Spreng, 2004), since LPG and a variety of other commercial cooking options became accessible to rural residents in Himachal Pradesh, residents have been "stacking" stoves and fuels. We have observed variations in levels of stacking and the trend seems to be that a wider variety of cooking and heating devices is becoming available. We focus here on three major stove types common in the Kullu region—LPG, tandoor, and the traditional mud stove. Other devices include electrical immersion coils and cylindrical metal tanks called a "hamam" used for heating water, as well as electric induction stoves, which have recently emerged on the market (see Fig. 1 for some examples). The tandoor is a rectangular metal box with one to three potholes on the surface, an opening on the front to feed in firewood and air, and an add-on flue. The most common tandoors are manufactured and sold in Kullu town. Cooking on LPG implies having a sleek and shiny aluminum stove, connected to a cylinder via a rubber pipe, with two burners and knobs to control the intensity of fire. The mud stove, often referred to as *chulha* ("hearth" in Hindi), is usually a U-shaped stove made from a mixture of mud, cow dung, and clay and placed against a wall. Other traditional stoves include a metal tripod or three stones open fire.

Fig. 2. The numbers of households with various stove combinations, organized by caste and possession of LPG, summarizes the distribution of various stove stacking combinations found in the 200 surveyed households (Jagriti, 2014b), broken down by caste and LPG presence. Out of the 200, 88 households belong to OC, or higher castes, and 112 to SC, or lower castes. It shows that the 52 non-LPG households primarily consist of SC families with lower economic income, the majority of which rely solely on tandoor for cooking and heating, followed by chulha solely, and tandoor plus chulha. This suggests that stacking is less likely to happen for lower social economic groups.

The lower caste households stand out not as the pioneering LPG adopters, but rather, as chulha "disadopters." Among the 148 households with LPG, more than twice as many OC families ($n = 34$) have chulha in their stove mix as SC families ($n = 16$). [3] LPG plus tandoor seems to be the most widespread combination among OCs and SCs.

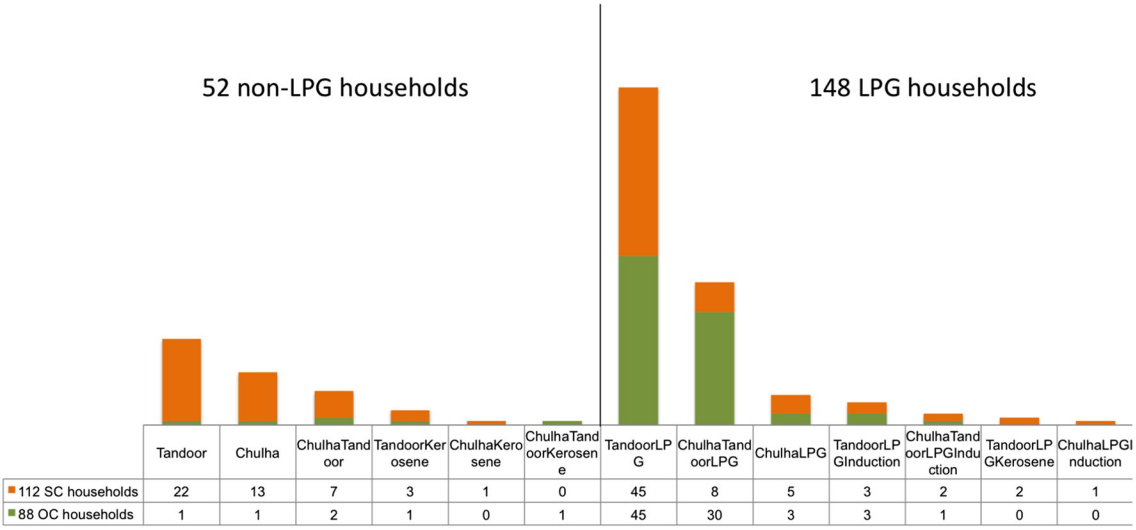
[3] We ran a binary logistical regression ($N = 200$) and found that the absence of a chulha is positively associated with being lower caste ($p < 0.02$) and with having LPG ($p < 0.01$), The model's R-square value is below 5%, meaning these two factors alone are not enough to explain the chulha's absence. This survey data set is comprised primarily of binary data, and despite various attempts, the models could only capture a tiny portion of the overall variation. We also ran a two-sample means T-test of percentages of chulha presence among LPG-owning SC and CC households and chulha presence is significantly higher in SC households ($p < 0.03$). Despite the inconclusiveness of these statistical exercises, they still point to illuminating trends that our qualitative data support and provide deeper insight.

**Fig. 1.** Left: A tandoor stove. Upper center: a mobile vendor selling induction stoves. Lower center: A household with a modified chulha (an added flue pipe). Upper right: A woman cooking Bhuturo on her chulha. Right middle: A woman reheating a roti bread on the LPG stove. Lower right: A tripod stove in the center of kitchen.

Nobody uses LPG alone. Overall, not only do more people have tandoor (174) than LPG, but most people in the Jagriti survey also list it as a primary stove and use it for more than half of the time. Household interviews indicated that households can meet their needs if the tandoor is their sole cooking technology, which is not the case with LPG. Thus, we find that both LPG's and tandoor's presence probably contribute to disadoption of the chulha. Higher caste households seems more likely to retain their chulha. In the following sections, we discuss user experience with each type of stove and analyze what access to alternative cooking devices and caste, as well as a host of other situational triggers and underlying drivers, have to do with displacing chulhas.

*Cooking with gas: diffusion of LPG stoves*

In 2001, Jagriti launched an energy program to encourage the adoption of LPG cookstoves, supported by a Norwegian donor. Jagriti's director recounted many reasons that households might choose LPG: it is clean, easy to operate, potentially healthier than cooking with wood, and it can be perceived as a status symbol. It was also intended to reduce pressure on especially slow-growing hardwood species in the forest, which were favored for fuelwood. Smith et al. (2005) find that LPG "reliably" produces much lower air pollution and emits "far less" greenhouse gases than poorly combusted and/or non-renewable solid biomass and kerosene.




| | Tandoor | Chulha | ChulhaTandoor | TandoorKerosene | ChulhaKerosene | ChulhaTandoorKerosene | TandoorLPG | ChulhaTandoorLPG | ChulhaLPG | TandoorLPGInduction | ChulhaTandoorLPGInduction | TandoorLPGKerosene | ChulhaLPGInduction |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 112 SC households | 22 | 13 | 7 | 3 | 1 | 0 | 45 | 8 | 5 | 3 | 2 | 2 | 1 |
| 88 OC households | 1 | 1 | 2 | 1 | 0 | 1 | 45 | 30 | 3 | 3 | 1 | 0 | 0 |

**Fig. 2.** The numbers of households with various stove combinations, organized by caste and possession of LPG.

However, becoming an LPG user is a challenge for rural residents. Before Jagriti's intervention, Lag Valley had no LPG users or delivery of LPG refills according to the closest gas agency manager in Kullu town. The government subsidizes the cost of LPG[4] and invites private dealers to operate the gas agencies. These hybrid agencies manage end-users and deliver cylinders, and there is not much incentive for them to deliver into rural areas with low demand for LPG and high overhead cost (D'Sa and Murthy, 2004). An aspiring customer has to go through a series of bureaucratic procedures to establish an LPG connection with the agency and pay as much as 4000 rupees (65 USD) to register for a LPG ration book, own one LPG cylinder and a special LPG stove, which are often sold in a bundle.[5]

To overcome some of the hurdles, Jagriti initiated several strategies. The director convinced the Kullu gas agency to start delivery in Lag Valley by promising that a big number of households would sign up. Group members contributed about half of the standard price. Jagriti transported the women to the agency to submit the application forms as required. It then negotiated a discount with a supplier of LPG stoves and pressure cookers to buy in bulk and transported the products to the members.

Dissemination of the information about LPG progressed through Jagriti's networks of WCSGs. Jagriti maintains and pays six to eight women as group organizers (GOs) who are usually from the higher Rajput caste with some education. The GOs went on to promulgate the LPG program among the WCSGs. Initially, they mainly told WCSGs in their own higher caste villages. The director attributed this to GO's unwillingness to interact with the lower caste. To avoid a skewed distribution toward higher castes and wealthier households, Jagriti made special effort to reach out to SC households. It encouraged groups of both castes to lend money for members to purchase the stove.

Both Jagriti (2014b) and our qualitative data show that LPG is overwhelmingly loved for its time saving feature, followed by its smokelessness, and consequently leaving cookware clean. It halves fuel consumption and time spent collecting fuel. It saves time and effort by reducing the need to chop wood, light and tend a fire, and scrub off soot from pots and pans. LPG is considered most useful for reheating food, cooking for guests, and whenever the cooks are in a hurry.

Despite this overall satisfaction with LPG, however, usage rate is low. Annual consumption is around 3 cylinders, compared to the national average of 7–8 (Ranjan, 2012). We summarize three main reasons based on Jagriti's survey and our own field findings: food preferences, logistical difficulty, and recurring costs of refilling cylinders. Very few households use LPG to cook roti, a type of flatbread consumed at almost every meal. Usually, roti dough is first cooked on an iron pan on the chulha or tandoor, and then placed directly on top of the flame for a few seconds until it puffs up. Users find roti made on LPG unpalatable. Some suggest that the gas itself imparts a bad flavor and that LPG roti gives people a gaseous stomach. Still, we observe that some users reheat roti directly in the LPG fire. Elsewhere, urban dwellers seem to have adapted to cooking roti on LPG stoves. The same problem affects the making of the traditional food of bhutoru—a thick sour dough flatbread common in the area. In some ways, LPG to rural Himachalis resembles microwave oven to urbanites, convenient, fast, but unable to fully replace a cookstove. Interestingly, restaurants in urban centers often list roti or bhutoru made on wood fire as a specialty food, reminiscent of the brick oven pizza in the West. Thus, adaptation transpires gradually as circumstances shift.

After the acquisition of a LPG connection, refilling gas is another story. When gas runs out, villagers normally place their empty cylinders before the scheduled delivery date with a nearby shop owner who charges 20 rupees for the handling. Sometimes, they miss the pick-up date, while other times the truck arrives days later. Some interviewees note that they do not live close to a shop and they have to bring the cylinders on a vehicle to the nearest drop-off points. In contrast, urban residents usually enjoy delivery of refilled cylinders at their doorsteps.

Refilling a 14-kg LPG cylinder costs around 450 rupees. Interviewees talk about how they ration gas and save money by "using it slowly" or selectively, as to only make tea, rice, and other quick foods. LPG is not economical especially when the villagers make slow-cooking dishes like pulses and when a large family requires significant amounts of cooking, given they have fairly stable access to free firewood. One conversation in a group discussion in the SC village of Baagan goes:

> Woman: "If you give us a second cylinder. I will not harm the trees."
> Interviewer: "But how would you have money for refill?"
> Woman: "Well, you lower the price!"

This exchange indicates both the utility of having a second cylinder to reduce the risk of a supply disruption due to a delay in the refill process, as well as the financial burden of using gas. Interestingly, the woman used forest protection as a bargaining chip. It perhaps reflects the sensitization of the villagers by both the state and conservation groups, as she likely associates the interviewer with Jagriti.

Jagriti has made LPG more accessible by removing barriers to establish LPG connection for the village women of different castes and income levels. However, full utilization remains elusive, as a result of the bureaucratic application process, unequal access to energy services provided by the government, irregular delivery of refills, precarious arrangement with the shop owners, as well as cooking practices and food preferences. All these complex conditions then contribute to the risk-averseness of rural fuel users and challenge what we mean by access.

### *The tandoor stove: a better substitute?*

In addition to LPG, the tandoor represents another alternative to the traditional chulha or open fire. The British Morovian missionaries are said to have introduced the tandoor into Himachal as early as the 1930s, when its use was first documented in Lahaul and Spiti district in upper northwestern Himachal (Negi, 2014). Before the tandoor arrives, people commonly use a *geeta* (an open hearth), which was a shallow depressed circle in the center of the kitchen to hold the open fire. Jagriti (2014b) suggests that tandoor is present some 20 years ago.

The local market for the tandoor stove is thriving. One big manufacturer, based in Kullu town, produces almost all of the tandoors seen in the villages. The tandoor maker started his business in 2003 and has been making tandoors since the early 1990s. He believes that the tandoor design is brought to Kullu from Lahaul and Spiti about 15 years ago, and he subsequently adapts the design to make various sizes and shapes, which he sells in Kullu and to neighboring districts, with features suited for particular climates and cooking practices. For example, the current model he sells to the colder Lahual and Spiti contains a baking chamber. He estimates that only 20% of villagers had a tandoor when his business started, but now close to 80% have them. His cheapest tandoor sells for 650 rupees (11 USD), with the flue pipe sold separately for another 3–5 dollars depending on the length. Most often, women and men come to his shop to buy the tandoor with women choosing the model and men carrying it, according to him. If coming from afar, only men would show up.

The tandoor possesses many advantages according to users interviewed. It provides better heating than chulhas for the winter and it can be removed during warmer seasons. The flue pipe can heat up the upper floor as well, if it goes through the house. It produces much less smoke than chulha and can cook the same dishes. In addition, the tandoor accommodates more than one pot, like LPG, allowing simultaneous cooking. Most households can easily afford a one-time payment

[4] At the time of fieldwork, each household was entitled 9 bottles of subsidized LPG each year. Since then, the annual quota has been raised to 12.

[5] For more detailed descriptions of the LPG acquisition and diffusion process, see Wang (2014).

for the tandoor. It typically lasts 5 or 6 years before it rusts through and needs to be replaced.

Almost half of tandoor users complain that it uses more firewood than the mud chulha. Dundi (2012) shows that on the basis of thermal efficiency, the chulha is slightly more efficient than the tandoor. However, to satisfy both cooking and space-heating demands during the cold season, which lasts up to half of the year, the tandoor uses less firewood than chulha. This explains users' mixed perceptions, as the tandoor can be both effective and yet inefficient.

However, the tandoor is not ideal for year-round cooking. It can overheat the house in the summer. As a result, the majority of tandoor-users interviewed rely more on LPG or chulha during summer months, and use their tandoor only during early mornings and late evenings. Some even shift it outside the house or disassemble it and put it aside completely during the warm season. For these households, this is a reason to keep their chulha. Overheating could present a barrier to tandoor's wider adoption, especially at lower altitudes where the climate is warmer. In addition, a few also complain that wood must be chopped into smaller pieces in order to fit into the stove's firebox.

Tandoor could also become an inconvenience for menstruating women. When asked why one SC woman lacks a tandoor, she answers, "The gods do not allow it." In her house, women are allowed back in the kitchen on the fourth day of their period, but they are still not completely "clean." If they touch the tandoor with a flue going out of the house through the attic, they would pollute the gods' residence through the pipe. Upon being further questioned of the logic, she added that earlier she had a fire in her kitchen. She thought the tandoor was to blame for antagonizing the gods, so she took it out. She has asked Jagriti to give her a new tandoor through the new improved tandoor project it was initiating in summer 2013 and she would install it in such a way that the pipe would stay away from the attic. Another SC woman tells that during her period, when the rest in the family are busy, she has to revert to the tripod to cook outdoors for herself. In such manners, religious beliefs can seep into the design of the kitchen and fuel rationales for stove decisions. Next, we turn to chulha and examine the difference in chulha ownership between castes.

### *Chulha: the sacred and the polluting*

We have already described several reasons why households keep their mud or tripod stove because of their comparative advantages over LPG and/or tandoor. Here we discuss several triggers and drivers leading to their removal. Some factors are situational in nature, while others are related to socio-demographic characteristics and attitudes about pollution, cleanliness, and modernity.

One situational trigger occurs when newly married couples separate from the extended family. Another may occur when households renovate their kitchen. For example, several informants mentioned that when young SC men marry and create their own living space within the family compound, they can be constrained by space, and stove stacking is limited too. Thus, they are faced with an either/or decision and opt for the newer device. In contrast, OC households, which generally have more living space, may have more room to "stack" stoves.

Household characteristics are also important. For example, the age structure in the family may have some effect. Younger couples may show less affinity toward chulhas. "The young want the more modern tandoor. The old are more habitual with old chulha," comments the tandoor manufacturer. His use of the term "habitual" refers to preferences for food preparation and taste. Among households interviewed in this study, three of the four OC households who have rejected their traditional stove have no members older than 60 years. In the same vein, a young and educated housewife from a wealthy OC household says she has to use a chulha to suit the taste of her aged in-laws. However, many of the SC households that had rejected the chulha have senior members.

Access to firewood is another important determinant of stove choice. SC villages typically have more limited access to fuelwood because they occupy less wooded geographical locations and own less land (Kharkwal, 1993).[6] In Lag Valley, lower caste communities are situated at lower altitudes and around riverbanks, while higher caste communities inhabit higher altitudes closer to forests with their cultivated land usually on open and flat areas of hilltops. Around Kullu, there are thriving apple and pear orchards owned largely by higher caste families. Regular pruning provides them with a stable source of firewood, but less so for land-poor SCs.

Perceptions of firewood scarcity are also intriguing. The lead author poses the question "why many SCs have no chulha" to a group discussion in Bhalyani, which her Rajput translator presents as the best-educated and land-rich village in Lag Valley.

> A woman who keeps her chulha: "They don't have firewood." Interviewer: "But you just said you think chulha uses less firewood." Woman: "It is their own mind how they think."

It is not easy to unpack the meaning of her argument. She appears to be making two assertions: first, that SCs lack access to firewood, and second, that SCs wrongly perceive chulhas to be less efficient than tandoors. Moreover, she may also have been catering to the outside interviewer by asserting that the reason she retained her own chulha is that it is more fuel-efficient than the tandoor.

The extent to which firewood scarcity actually affects stove choice will require more scrutiny and is beyond the scope of the paper. Some evidence suggests that Kullu's forest cover has not changed significantly in the past 150 years (Berkes et al., 1998; Gardner, 2002). The data from the series of Indian State of Forest Report published between 2003 and 2011 show that "very dense forest" in Kullu jumped from 117 to 586 hectares in between the 2005 and 2009 assessment, while "moderately dense forest" diminished from 1297 to 785 hectares; therefore, the overall size of forested area remains stable.[7] However, property rights to forest, agriculture, and grazing land overlap and individual village's reserved forest size and ability to access may vary greatly (Berkes et al., 1998).

Despite that half of the tandoor users complain about its (perceived) inefficiency (Jagriti, 2014b), many women continue to use tandoor because, as we argue, it is unequivocally cleaner than chulha. Pollution from chulha and its anti-modernity image, as we will lay out in the following paragraphs, help drive households' decision to abandon it when opportunities present. Both SC and OC women who live in households without chulha mention the chulha's smoke level is unbearably high. However, concerns about smokiness are primarily focused on cleanliness and aesthetics rather than health. The most frequent complaints by interviewees are of their soot-blackened kitchen and cookware:

> "We moved to a new house and got rid of the chulha because we don't want the smoke to blacken it," tells a WSCG group member in the SC village of Galyana."The utensils got more blackened (by the chulha). Roofs got blackened (*kaali hoti*). Everything got dirty," says one WSCG woman in the SC village of Sheildali."I don't want a chulha to blacken my kitchen and spoil my decoration." The WSCG group leader in Sheildali in another individual interview says, "The wood is here very wet. Rooms get blackened, so are clothes and ourselves."

None of the group leader's neighbors have chulhas, as far as she knows. Two out of the four non-chulha OC interviewees mention blackening as a reason to switch.

[6] In fact, the landless schedule castes were slowly allocated land over several past land reforms (Berkes et al., 1998).

[7] This report was published in 2003, 2005, 2009, and 2011 by the Ministry of Environment and Forestry.

Still, interviewees are not completely ignorant of the health impacts of smoke exposure. OC respondents show more awareness of the chulha's health impacts, which in some cases prompt modifications but not removal. A Bhalyani woman who is asked if the smoke from her chulha bothers her responds, "It matters for health only in the future. After I get more money, I will use more gas." Another seemingly wealthy household living in a three-story concrete building (instead of the traditional wood and slate structure) in Bhalyani has a large chulha with a self-constructed clay chimney hood attached. In the neighboring Shangan OC village, one husband, a former military man, has attached a flue (the same kind used for tandoor) to the chulha. No SC informants make unprompted references to health. Thus, despite a few references among OC informants, health concerns are not major drivers of chulha abandonment.

In Sheildali, an SC community where two of the above quotes about chulha's smokiness are recorded, reasons given for abandoning the chulha also relate to the tandoor's modern image. The five households interviewed have no chulha, but maintain a three-stone fire outside to heat water for bathing and preparing animal feed. This could suggest the compromise between the persistent utility of traditional stoves and a desire to modernize. The interviewees also answered that they are not aware of any neighbors who still have chulha inside their homes. One non-Jagriti member without an LPG in Sheildali says, "The chulha belonged to the past generation." She has recently bought an induction stove in Kullu town, having seen advertisements on TV. Another non-member tells the story that when she was married into a Sheildali family, she "threw away that thing (a tripod chulha). It is an old-people thing." Her rejection of the chulha is also triggered by a fire incident: a long stick was left burning in the tripod and the house caught fire. They moved the kitchen into the attic afterward.

The desire for material cleanliness, exemplified by the quotes listed above, can also be considered an expression of the symbolic meaning of purity and pollution within the semi-sacred space of the kitchen. Switching from a chulha to a tandoor or LPG can purify the house in both the cosmopolitan and ritual sense of the word. We propose that the SC households' demonstration of a greater willingness to switch technologies could indicate a desire to "come clean" and up their social status. To explain individual and group choices, we seek each caste's perception of their own behavior, as well as of the other's. In response to questions about why many SCs have no chulha, a woman in the Bhalyani OC village discussion group says, "If an SC does not have money, he will keep [the] chulha… It is the habit of the SC to earn money and spend it all on gas." This implies her perception that the SCs are getting wealthier but they do not know how to ration their resources. This informant is the only person in the group who has removed her chulha because it produces too much smoke. Then, in response to another group member's assertion that the god of *agani devta* lives in the fire and "it is a holy process to get up early and light the chulha and leave a little food in the chulha to burn," the tandoor-using informant continued, "With [the] tandoor, you can still give offerings (*ahuti*)." When asked why SC households have a greater tendency to reject the chulha, the tandoor maker, himself a high caste originally from Nepal, responds:

> "Maybe the SCs want to show off that they are becoming rich. *The SCs are always trying to get into the OC's kitchen* (emphasis added)…because the OC's gods do not allow SCs to enter their kitchen. But the government made a rule that everybody is equal."

He perceives that the SCs use their economic improvement as a political lever, echoing the argument of Amar Bahadur (2008) about caste opposition—a point we will shortly return. Taken these narratives together with the comment about SC having no chulha because of lack of firewood, it seems that the higher castes associate the lower castes' poverty and inferiority with their ownership of chulha (and even if they get rich, they do not know how to manage their resources). But why so when they themselves tend to keep their chulha?

When a group in the SC village of Galyani is asked why OCs keep their chulha, the group leader, acknowledging first that she has never entered into the OC's kitchen, surmises that it depends on the wall. The OCs like to smear their wall with cow dung, which is costless. She buys paint to paint her wall. So, she could not afford to repaint repeatedly to cover the blackened wall. Cow dung, according to Dumont (1980), can be a powerful purifying agent since gods live within the cows, which is perhaps why the OCs use it. OCs themselves offer more pragmatic reasons about why they continue to use chulhas. The majority list better tasting roti bread, more choices of stoves during hot weather, and cost of gas as the most frequent reasons. In a nutshell, we argue that for the higher castes, chulha represents their spiritual superiority and they can afford to stack stoves.

This is why the way the energy ladder model depicts the relationship between advance level of stove/fuel and income level is insufficient. Income itself is a contextual and composite measurement. Being an SC or below poverty line means entitlement to a range of provisions by the government. Some borderline villages have consciously chosen to register themselves under the SC category to receive benefits. The other SC interpreter, however, resents the fact that receiving benefits made the SCs further looked down upon by the higher castes. While different caste groups hold certain characteristics with regard to land ownership, geography of their village, cash income, household composition, etc., household surveys suggest that caste, cash income level, and land ownership do not always align. There are rich SCs and poor OCs. The OCs, having more land, tend to engage in more subsistence and commercial farming. The SCs, while often land-poor, engage in cash-generating activities, as agricultural laborers, weavers, construction workers, etc.

Many of these cash-generating activities also offer opportunities to interact with the outside world. In the SC village of Suma, several women work in Jagriti's office to make natural and health products as wage laborers. One family just recently finished building a new latrine equipped with a squatting toilet and sink, and walls plastered with decorated ceramic tiles. In an interview with a couple in Suma, the husband is eager to show the researchers their newly renovated spacious kitchen, with a built-in tiled platform at waist height that holds the LPG stove and a sink. The tandoor is in the middle of the room. The husband works as a janitor at an international meditation center in Kullu town. Foreigners from the center have visited their house several times.

These kinds of experience and contact with the modern world help fuel conceptions of a modern and clean kitchen. It is in ways like these that centers and peripherals exchange perceptions of each other. Those at the bottom of the social ladder selectively borrow practices esteemed by the upper castes, and more so by the outside modern world as a political vehicle to raise themselves up in opposition of the privileged—they are the "cosmopolitan" SCs, to borrow from Pigg (1992). By investing in upgrading their kitchen, the lower castes could avoid the traditional social-religious structure of power politics and seek empowerment via the project of modernization.

The chulha thus carries different meanings for different castes. For the SCs, it pollutes their environment and perpetuates the religious stigma that they are impure. For OCs, pollution is less of a concern. Practices associated with chulha use, including applying cow dung to cover blackened walls, and adding chimneys to reduce smoke, symbolize their political and ritual superiority. One can thus argue that the aspiration for a clean and modern kitchen is strongly influenced by the simultaneous pursuit of purity and modernization.

## Conclusions

In this paper, we have documented the on-going social processes shaping the kitchen space of hillside villages in the Kullu valley in Northwestern India. We have traced the introduction of new cooking

technologies like LPG and tandoor stoves as well as the removal of the traditional stove chulha. Through the story of the LPG diffusion, we show that removing barriers of access to modern fuel in a socially, economically, and spatially stratified society, is a much negotiated and contested process. The diffusion of LPG initially favored the higher caste and wealthier families, influenced by the social networks of Jagriti's field agents. Despite Jagriti's efforts to remove the bureaucratic, financial, and physical barriers of establishing LPG connections, use of LPG continues to be limited by prevailing structural, especially infrastructural, conditions. At the other end of the spectrum, the rejection of chulhas appears to be driven by the organic arrival of the affordable tandoor and the LPG intervention.

In addition, we emphasize the "social process" of chulha's abandonment for the notable difference in different social-religious groups' attitudes toward chulha and ability to stack stoves. It seems that for the lower castes, objection to the chulha's smokiness is not driven by health concerns, but by a rejection of the tangible stains left on their surroundings and on themselves: walls, cookware, hands, and clothing. By removing the chulha, simultaneously purifying and modernizing, we argue that the lower castes perhaps make the statement that they deserve better. Their claim to better circumstances may arise from their relative economic improvement and/or the constitutionally enshrined affirmative action. They are actively repositioning themselves on the social and the energy "ladder"—motivations that can constitute the so-called aspirational demand. On the other hand, the higher castes primarily associate chulhas with ritual purity. They also value it for their perception that food cooked on the chulha has superior taste, an opinion that is strong among elders. The fact that the higher castes tend to own more land and living space, have greater access to fuelwood, and are generally wealthier all together makes it easier to stack stoves as well.

As new stoves and fuels become available, people adopt those that are better suited for various aspects of their household cooking and heating needs. The energy ladder, which theorizes a relationship between income and stove/fuel choice, retains some explanatory power but the relationship is much more convoluted. Even when higher income levels do correspond with more advanced fuels/stoves, it does not address the underlying complex configuration of factors that produce stacking. The household cook also retains her own agency, making choices within the numerous constraints imposed by her gender, class, and caste.

Despite these stark differences, it is worth noting that transitions in cooking practices are occurring in both groups to some extent. And, in every transition, a tradition, practice, habit, or preference is negotiated away. Neither culture nor taste is static; both are slowly but surely shaped by exogenous political and economic forces (Mintz, 1985). Even as labs in Delhi, Bangalore, and the West churn out new models of improved cookstoves every day, life too in the villages, periurban, and urban areas is constantly refashioning itself. With modernity, comes utility, social status, and compromise. Some adapt faster than others.

There are more questions to explore, however, such as decision-making and agency-sharing within the household. Better survey data could be used to capture geographic conditions faced by households that can shape their fuel choices. Although the caste system is in some ways particular to Hindu societies, its nature of overlapping racial, cultural, economic, and religious delineations reflects on societies anywhere. Through the detailed case study, we can see decisions around energy choices play out in differential ways even in seemingly homogenous society. More such studies into other cultural political systems would yield more valuable insight into a new framework on household energy transition.

These complexities, nuances, and contradictions should help expand our thinking on mechanisms to enhance access to modern energy for the poor and the poorer, conditions under which revolution of the kitchen can happen, and how the "dirtiest" cooking practices can be eliminated. Governments, NGOs, and donors should identify and help accelerate ongoing social and technological transformations that can improve conditions of kitchens, health, as well as dignity. Subsidies, together with infrastructure improvement and segmented products, are all necessary tools to deliver the health outcome by meeting demand for aspirational products. Local markets for affordable and customizable clean cookstoves such as the tandoors are critical too. For those who retain their chulhas for various values as we have addressed, improving ventilation can be a very cost-effective intervention. Other options include promoting more efficient tandoor stoves, building local production capacity and quality, introducing improved biomass stoves that are suitable for summer use, and offering kitchen modifications like chimneys. To truly revolutionize kitchens will require a bundle of interventions, including improvement in physical infrastructure and markets.

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