Fuel-efficient stoves for Darfur: The social construction of subsistence marketplaces in post-conflict settings

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Abstract

This paper explores the development of market roles and transactions in fuel-efficient stoves in Darfur from 1997 to 2008 as a grounded example of how subsistence markets are socially constructed in post-conflict settings. Using a combination of archival texts, interviews, and real-time discourses by protagonists, this study explains the who, what, why and how of emergent marketplaces by showing how development interventions come to imbue market participants and transactions with socially (re)constructed meanings. The fitful emergence of subsistence marketplaces for fuel-efficient in Darfur is punctuated by development interventions which at times under- or misrepresent market participants and by successes and failures in bringing together trainers, producers, sellers, consumers and users of fuel-efficient stoves. Subsidies and handouts delay and distort the emergence of grassroots demand, choices, and prices; a plurality of competing development interventions re-shape the supply. By the end of 2008, the subsistence market for fuel-efficient stoves catches momentum, engaging over 52% of the Darfuri communities in market transactions for the product. As market participants gain voice and influence they reshape the market to favour mud stoves over metal stoves. Reports by several development organizations suggest that among fuel-efficient stove users, 90% use mud models, and 49% of women who own both mud and metal stoves prefer mud stoves.

Keywords

Subsistence marketplaces; Critical discourse analysis; Development interventions

1. Introduction

Globally, 3.7 billion people are largely excluded from formal markets (World Economic Forum, 2009); collectively they earn an annual income of US$2.3 trillion a year and their income is growing at about 8% annually. By 2015 their aggregate income pool could exceed US$4 trillion. Some 2.6 billion people worldwide – more than half of the world's population – continue to subsist on less that US$2 a day; of these, 1.6 billion earn between US$1–2 per day, and one billion people live in extreme poverty, earning under US$1 per day. Despite being resource-poor, barely having sufficient resources for day-to-day living (Viswanathan and Rosa, 2007) and despite being often shut out of formalized market transactions (Karnani, 2007), the poor engage in vibrant market exchanges (Viswanathan et al., 2008a,b). Recent reports estimate the collective purchasing power of subsistence consumers at US$5 trillion, with assets of US$9.3 trillion (World Business Council for Sustainable Development, 2008: 48). Subsistence consumers "cope with difficult circumstances: low and fluctuating incomes, domestic constraints, and a lack of information. Yet, they are committed to improving their lives and will extend themselves to take on opportunities for growth and advancement" (World Economic Forum, 2009: 10). Muhammad Yunus, 2006 Peace Prize Winner, challenges researchers and practitioners to develop new questions and solutions to improve lives in subsistence marketplaces (Prasso, 2007).

A growing number of studies advocate the importance of stimulating indigenous economic activities in subsistence marketplaces (Jackson et al., 2008, Peredo and Chrisman, 2006). Engagement in such activities encourages experimentation with locally-fit business models (Branzei and Peneycad, 2008) and creates a self-reinforcing cycle of empowerment (Abdelnour et al., 2008). Stimulating subsistence marketplaces is essential, and challenging, in post-conflict settings (Fort, 2007), where torn social fabrics disrupt one-on-one exchanges, hindering market-based approaches to post-conflict reconstruction (Fort and Schipani, 2004). Crafting local market exchanges can help the poor cope with the direst of circumstances (Ayudurai and Sohail, 2006) and often provides faster recovery than aid. Yet lessons of postwar market resuscitation are rife with myths, set-backs, and historical baggage (Willams, 2008) which risk holding back theorizing on how interventions that stimulate the emergence of subsistence markets in post-conflict settings can accelerate economic recovery (Fort and Schipani, 2004).

This study explores the social construction of subsistence marketplaces in the aftermath of armed conflict. Because war disrupts social relationships, development interventions often scaffold the creation of subsistence marketplaces (Teegen et al., 2004). They channel substantial resources, orchestrate local collaborations, and can shape policy by shifting the agenda of multilateral donor agencies (Brown et al., 2000). But many international development interventions face criticism for tunnel-vision or short-termism, and relief from oppression, exploitation and marginalization is often short-lived (Anderson, 1999). Even market-centered development interventions which explicitly set out to encourage local transactions

often fail to promote self-sufficiency and resilience for consumers in subsistence markets (Karnani, 2007).

Since 2004, development interventions increasingly focus on growing subsistence markets. Development interventions are particularly critical in post-conflict settings (Abdelnour et al., 2008); they promote new forms of economic cooperation (Abdelnour and Branzei, 2009) and encourage social trust across fractured relationships (Viswanathan et al., 2010-this issue). Development interventions can help promote social change in subsistence markets and have catalytic effects in post-conflict settings (Fort, 2007, Willams, 2008). Yet they can also delay social change or even divert or distort relational patterns, reifying dependence and stalling emancipation (Cornwall and Brock, 2005, Lewis and Opoku-Mensah, 2006). The emergence of a subsistence market for fuel-efficient stoves in Darfur explains how these positive and negative aspects come together to shape market roles and transactions.

As development organizations compete for funds, attention and people (Brown et al., 2000, Florini, 2003), they often rely on discourse as a strategic resource to gain legitimacy and enact social change (Hardy et al., 2000). Showing that consumers can respond selectively and adaptively to development interventions extends the field's understanding of the evolution of subsistence marketplaces in post-conflict settings by exploring how market roles and transactions are socially constructed. The research also extends and complements insights on subsistence marketplaces from a base of pyramid lens (Karnani, 2009) and a social enterprise perspective (Peredo and Chrisman, 2006) by explicating the social construction processes that help market participants overcome resource and skill scarcity to weave highly interdependent and personalized exchanges (Viswanathan, 2007).

Exploring up close how subsistence marketplaces come to be socially constructed in the aftermath of conflict yields powerful insights for practical interventions by critically analyzing the upsides and downsides of the discursive strategies of development organizations operating in postwar settings (Lawrence et al., 2002). The grounded findings suggest that development interventions represent and enable market roles and transactions; their discourses under- or over-represent the voices of consumers in ways that may distort the emergence of subsistence marketplaces. Understanding the social construction of development interventions thus helps shed new light on the early successes and early failures of development interventions in post-conflict zones (Anderson, 1999, Willams, 2008) and highlights the critical relevance of nurturing consumer skills in order to enable or hasten the emergence of subsistence marketplaces in war-torn communities.

2. Fuel efficient stoves in Darfur

The study takes a critical approach to explore how development interventions influence the emergence of subsistence marketplaces for fuel-efficient stoves (FES) in Darfur over a ten-year period, 1997–2008. The inquiry starts as the US imposes

economic sanctions on Sudan in 1997 and spans the 2003 humanitarian crisis, the signing of the Comprehensive Peace Agreement (January 2005) and the Darfur Peace Agreement (May 2006). Development aid to Sudan triples between 2003 and 2005, from US$609.8 million to US$1787.2 million. The USAID portion increases six-fold over the same period, and eleven-fold from 2001 to 2005, as USAID reengages in Sudan after a seven-year absence.

This study examines data over a ten-year period, providing a unique window into the fitful emergence of subsistence marketplaces in post-conflict settings. Local and international development organizations intervene in the design, production, marketing, diffusion, adoption and utilization of FES in Darfur, Sudan. They use discourses strategically (Hardy et al., 2000) to gain legitimacy and attract resources. The study examines the social construction of market participants and market transactions through and across the evolving discourses of development organizations engaging in post-conflict interventions in Darfur.

The focus on Darfur is motivated theoretically and empirically. Theoretically, severe disruptions in social relationships and patterns of transactions among Darfuri internally displaced persons (IDPs) creates an exchange vacuum that offers a baseline for studying the emergence of subsistence marketplaces. As Darfuri IDPs reweave a subsistence economy, fuel-efficient stoves are one of the very first market-based development interventions. These interventions pattern the gradual emergence of trainers, producers, sellers, consumers and users by discursively promoting and contesting specific relationships and exchanges. The discourses of development organizations initially under- and later over-represent the voices of consumers and users of fuel-efficient stoves in an effort to gain attention, legitimacy and resources for FES projects. Tracking these discourses as they unfold makes clear the important role of social construction in the early development of subsistence marketplaces. Empirically, the accessibility and transparency of multiple texts provides a rich and reliable account of the technology and the market exchanges as they evolve over time, enabling rich contextualization and triangulation of evolving market roles and transactions from multiple standpoints.

3. Subsistence marketplaces in conflict settings

Three research streams on the base of pyramid, social enterprise and subsistence marketplaces tackle complementary aspects of market exchanges in impoverished communities. Collectively, the streams grapple with the shared challenge of engaging the poor as producers and consumers in ways that overcome “traditional stereotypes and mindsets about who they are and what they can accomplish” (World Economic Forum, 2009: 8).

Base of pyramid (BOP) arguments (Prahalad and Hart, 2002, Prahalad, 2005) portray the poor as resilient and value conscious consumers. They draw attention to the untapped potential of subsistence marketplaces to encourage disruptive innovation that addresses unmet needs (Walsh et al., 2005) and creates new

markets (Rangan et al., 2007, World Economic Forum, 2009). Critical views suggest that BOP arguments "romanticise" the poor (Karnani, 2009), mistake wants for needs (Karnani, 2007) and overlook literacy and resource barriers (Viswanathan and Rosa, 2007). This consumer-centric view informs theoretical and empirical research on stable subsistence marketplaces, such as India, but is problematic in conflict settings on two counts. First, consumptions arguments rely on product/service offerings and ongoing market transactions, yet in the aftermath of war both social relationships and economic transactions are fractured. New forms of exchange and economic cooperation emerge (Abdelnour et al., 2008, Abdelnour and Branzei, 2009) as greater attention is placed on market linkages — finding alternatives for transaction bottlenecks and drawing on social resources to assemble substitute connections (Viswanathan et al., 2010-this issue). Second, in post-conflict settings, gaps in supply and distribution networks render consumer-centric arguments powerless (Ayudurai and Sohail, 2006). Without suitable investment in governance and infrastructure, the promise of demand-driven reconstruction is a mirage (Karnani, 2007).

Social enterprise solutions to poverty alleviation (Seelos and Mair, 2007) take a closer look at grassroots models of economic development with twin goals of social betterment and economic emancipation. Growing interest in understanding barriers and facilitators of indigenous entrepreneurship in subsistence marketplaces suggest that social enterprise may offer at least a working ground for experimenting with new templates, roles and collaborations in stable settings (Jackson et al., 2008). Evidence from micro- and informal enterprises (Branzei and Peneycad, 2008, Willams, 2008) and/or community-based enterprises (Peredo and Chrisman, 2006) suggest that specific market transactions help anchor social enterprise models — as these transactions unfold, the social enterprise models morph and serve as replication templates (Abdelnour and Branzei, 2009). A handful of case studies document how entrepreneurs design models that overcome resource constraints to enable market transactions, but comparatively little is known about the genesis of socially-minded economic activities in the aftermath of war or social disruption (Abdelnour and Branzei, 2008, Ayudurai and Sohail Sadiq, 2006).

Research on subsistence marketplaces takes us one step closer by mapping the unique constraints and opportunities of market transactions among resource-strapped, low market literacy customers. Several studies theorize the behavioural aspects of economic exchanges, often embedded in rich, culture-specific, pre-existing traditions (Viswanathan and Rosa, 2007) and social networks which gradually nurture consumer and entrepreneurial skills (Branzei and Peneycad, 2008, Viswanathan et al., 2008a, Viswanathan et al., 2008b). Findings suggest that buyers and sellers are interdependent: deep, pervasive and highly-social one-on-one relationships scaffold their market transactions (Viswanathan, 2007, Viswanathan and Sridharan, 2009).

Research on subsistence marketplaces provides an important point of reference for new theorizing on the social construction of market transactions in post-conflict

settings by drawing attention to the socially-embedded, highly-personalized interactions that build, motivate, and sustain exchanges. Subsistence market contexts are "thriving environments, devoid of technology but teeming with relationship energies, and often invisible to the literate resource-rich world" (Viswanathan and Rosa, 2007: 6); individuals and communities struggle to meet the most basic needs, and to do so they engage in ubiquitous vibrant and beneficial exchange, their lack of capabilities or resources notwithstanding. Extending research on subsistence marketplaces to post-conflict settings, with extreme levels of uncertainty and lack of control, helps explain further the role of market transactions.

Furthermore, driven by the twin engines of consumption and entrepreneurship, subsistence marketplaces rely on tightly knit relationships which in turn require high levels of social trust. Because conflict often damages this social fabric, 1-to-1 interactions help "pave the way for the creation of reciprocal obligations and private information conduits" (Sridharan and Viswanathan, 2008: 457) which in turn help rebuild market and relational infrastructures (Lawrence et al., 2002). Prior research argues that marketing exchanges with poor consumers are unfavorably unbalanced (Alwitt, 1995) — "the economic choices of the poor are constrained by their market environment" (Banerjee and Duflo, 2007: 154). Furthermore, by under- or over-representing consumers, development interventions can hinder the emergence of subsistence marketplaces in post-conflict settings (Lawrence et al., 2002). The study takes a critical look at unfolding development interventions to encourage the emergence of subsistence marketplaces and show that their social construction influences the emergence of roles and transactions among market participants. The study takes critical lens (Cornwall and Brock, 2005) that helps unpack the meaning of specific actions and reactions by market protagonists (Heracleous, 2006). Critical management theorists argue for an "eclectic approach that favors rich diversity over rigorous contingencies" (Adler et al., 2007: 155) and thus encourage the exploration of points of disagreement and divergence in ways that contribute critically but organically to social change (Adler et al., 2007: 156–157).

4. Method: Critical discourse analysis

This study relies on social interactions and discursive dynamics (Alvesson and Deetz, 2006) to shed light on the social construction of subsistence marketplaces, shows how market participants (re)define their roles across market transactions, and reveals how development interventions may enable or hinder the emergence of subsistence marketplaces in post-conflict settings. Based on the core premise that "our experience is largely written for us by the multitude of conflicting discourses of which we are a part," such analyses unpack the "discourses that accompany the interventions and the complex processes of social construction that precede it" (Phillips and Hardy, 2002: 2). A critical discourse analysis methodology focuses inquiry into the processes of social construction and heightens attention to social embeddedness by drawing on geographically- and contextually-specific language (Fairclough, 1992). Studies of social interactions have used such analyses in a wide

range of contexts (e.g. refugee systems in the U.K., Phillips and Hardy, 1997; refugee camps in occupied Palestine, Lawrence et al., 2002; aboriginal communities in Canada, Phillips and Hardy, 2002).

Discourse analysis is a structured and systematic study of texts – including their production, dissemination and utilization – as a means to understanding the complex and evolving relationships among protagonists as they engage individually and collectively in the creation of social reality through discussions, debates, and rebuttals (Phillips and Hardy, 2002, van Dijk, 1997). "Discourses are shared and social, emanating out of interactions between social groups and the complex societal structures in which the discourse is embedded" (Phillips and Hardy, 2002: 4). Discourses are not autonomous but linked with other discourses in cooperative or antagonistic ways (Heracleous, 2006). Discourses can be used strategically (Hardy et al., 2000) and symbolically (Heracleous, 2006); they are fluid and often contradictory. A core premise is that development organizations deliberately alter their discourses to craft and attribute meaning to market participants and transactions (Anderson, 1999, Hardy et al., 2005).

4.1. Data

The study explores the social construction of fuel-efficient stove transactions in Darfur by analyzing written discourse (annual reports, special focus reports, consultancy reports, commissioned reports), periodic information sharing (newsletters, topic specific disclosures, advocacy and policy papers, newsletters, press releases, information posted to official websites, humanitarian emergency updates, funding proposals, concept papers and conference presentations), interviews, pictures and videos, and product schematics and technology descriptions (Grant et al., 1998). Overall, the data include over 450 documents and encompass over 3000 pages.

Data collection is organized around the key protagonists, introduced in Table 1. International Technology Development Group (renamed and rebranded Practical Action in 2005, ITDG/PA) is the first development organization to actively promote fuel efficient stoves in Darfur. In late 2004, CHF International (previously known as the Cooperative Housing Foundation), Refugees International (RI), Oxfam, USAID, the Lawrence Berkeley National Laboratories (Berkeley Lab), and the Aprovecho Research Center (Aprovecho) joining ITDG/PA to actively reshape ongoing debates on FES interventions in post-conflict Sudan. In 2006, the Women's Commission for Refugee Women and Children (WCRWC) gives voice to women IDPs; that same year, the Jewish World Watch (JWW) begins working with Darfuri refugees in Chad. The protagonists' discourses revolve around the FES users, the FES technology, and the FES market transactions; development organizations with Darfur-based projects reference debates within and among several international organizations including the UNDP, World Bank, FAO, and The Working Group on Climate Change. Corroborating and contradictory discourses selectively motivate and legitimate specific standpoints on the users, consumers, producers, trainers and sellers involved with FES projects in Darfur from 1997 to 2008.

Insert Table 1 Here

For each protagonist, the variety of texts ranges from public relations releases to internal documents, and from large-scale assessments by arms length third parties to in-house reflections, self-published newsletters, blogs and documentaries, and formal and informal orchestrated public interactions. The analyses sort these texts by intended audience and content. Some of the texts explore global triggers and global implications of local actions or engage international organizations in legitimating processes for local needs and asks (macro-discourses); other texts uncover proximal interactions and local priorities of the FES market participants to illustrate their evolving exchange relationships (micro-discourses).

4.2. Analyses

Fig. 1 outlines the key local and international development interventions aimed at promoting FES in Darfur between 1997 and 2008, on the backdrop of the conflict escalation in 2003 and the signing of the peace accords in 2005 and 2006.

Insert Fig 1 Here

The FES technology evolves fitfully during this period (Appendix A describes the sequential introduction of FES in Sudan, and compares the designs, costs and prices across competing technologies). Darfuri people traditionally cook using a three-stone fire. Reliance on increasingly scarce wood and the dangers to health from smoke inhalation, however, make improvements in fuel design and efficiency a widely desirable option. The mud stove, which relies on local labour and material, emerges early as a popular technology. Early FES efforts (1997–2004) champion mud stoves for three reasons. First, production is inexpensive, making mud stoves affordable for Darfuri IDPs. Second, their design and production deliberately involves Darfuri women IDPs who become the producers and the users of these mud stoves; interventions thus mesh user and producer roles and boost the supply of mud stoves. Third, as user-producers begin developing manufacturing capabilities, they can pass those skills on through a "train-the-trainer" approach that promotes local capacity building and helps ensure a recalibration of supply and demand along the value chain.

The standard mud stove design can be produced and transacted locally for US$1–3. In the mid-2000s, the ITDG/PA initial mud stove technology undertakes several changes in design. New features are added to further improve its fuel efficiency. By 2008, several models of mud and clay stoves are being exchanged in Darfur, with the latest design – the AviIII – costing approximately US$2.5 and selling for US$4. The design of the brick stoves is almost identical to the mud and clay stoves — except that its body is made of 6 bricks (Abdelnour and Branzei, 2008). By 2008, the mass-produced brick stoves, later known as the Rocket or magic stove, sell for as little as US$1–3 in Darfuri camps.

Early on, ITDG/PA also experiments with an alternative fuel technology by introducing Liquid Petroleum Gas cookers, which cost about US$10 a stove. Despite successes elsewhere, however, in Darfur the diffusion of LPG cookers remains limited. Another alternative technology, the metal stoves, modelled on the Indian-made Tara metal stove, becomes a strong contender to mud stoves once CHF customizes its design to the harsher conditions in Darfur. CHF also redevelops the initial model – i.e. the Berkeley Darfur Stove (BDS) – in partnership with the Berkeley Lab (from late 2004 through June 2007). Then, starting in 2007, CFH develops the Darfur FES (DFES) through collaborations with local NGOs.

Until 2005 ITDG/Practical Action promotes mud stoves and provides the training and the base technology in all of the Darfur-based FES international development interventions (Fig. 1). Starting in 2005, its interventions focus on either mud or metal stove technologies, with the former upholding a stringent local focus (promoting engagement and skill building by women IDPs): "The work undertaken by Practical Action Sudan is aimed at improving the livelihoods of poor communities in selected areas of the country through building the capacity of small-scale producers and their institutions" (Practical Action Sudan, 2008), and the later emphasizing superior efficiency, monetary gains and labour savings: "Implications of full adoption of the [metal stove, Berkeley Darfur Stove] throughout Darfur include […] monetary savings of US $222 per family per year for IDPs who buy fuel wood or a savings of 18 hours of labor effort per week for IDPs who currently collect fuel wood." (Amrose et al., 2008: 4).

Several concomitant attempts to improve fuel efficiency help reconstruct the role of market participants and FES transactions, in ways that gradually separate the design and production of the stoves from their users. Experiments with prices further unhinge consumers from users by proposing alternative approaches to pay for the FES. The scalability of user-benefits becomes one of the central motivations that supports this efficiency drive: "A Darfur refugee household receiving a Berkeley Darfur Stove immediately experiences a doubling of their disposable income (or earning capacity). The 2.2 million refugees in Darfur need about 300,000 stoves, so the challenge (and the opportunity) is to set up multiple full scale assembly shops" (The Blum Centre for Developing Economies, 2008).

The emphasis on scalability distorts the emergent subsistence marketplace on two counts. First, via price subsidies, since interventions project stove prices at a target scale of production: "Our current best estimates for the cost of producing [a metal stove] is less than 1000 SDD (US$4 November 2005 US) per stove when mass-produced. Custom-made single stoves cost 2000 SDD (about $9 November 2005 US) from a local sheet metal worker in El Fasher" (Galitsky et al., 2006: 31). This means that some development organizations heavily subsidize the higher production costs for the early runs. Second, demand forecasts stem from consumer needs instead of their ability or willingness to pay for the stoves: "A Darfur factory which would build 100 stoves per day (25,000 stoves annually) […] Annual output of this factory will provide $30 million to the Darfur refugees in avoided wood fuel costs, or income

earned from other remunerative activities, and also help the local and global environment" (Darfur Stoves Project, 2007: 24). Together, price subsidies and inflated demand forecasts widen the gap between supply and demand.

As projects proliferate, growing tension ensues between user-centric and efficiency focused interventions. ITDG/Practical Action argues that "The CHF approach is not moving towards sustainability. IDP housewives will return home without the knowledge of manufacturing the stoves, the best way to utilises their stove and the best cooking practices" (Practical Action Sudan, 2007: 2). CHF counters, claiming that "ITDG (Practical Action) Mud stove was the worst performer, using almost 90% of the fuel that the 3 stones fire consumed and emitting significantly more smoke" (Practical Action Sudan, 2007: 1). These contradictory discourses prompt the social (re)construction of roles and transactions in the FES marketplace, and has emergent consumers, sellers and distributors seeking a better balance between the high production costs on one side and the low paying ability of consumers on the other.

As new technologies such as brick stoves and solar stoves are introduced in Darfur and to Darfuri refugees in neighbouring Chad, and as increasing global attention to FES interventions motivates larger-scale projects by incumbents and newcomers, micro-discourses become increasingly fragmented. Market roles and transactions are iteratively contested and reconciled. As technology alternatives multiply (Fig. 1), conversations between incumbents (ITDG/Practical Action, CHF, The Berkeley Lab, and Aprovecho/International Lifeline Fund) and newcomers (JWW, WCRWC) bring the consumer to the fore and emphasize complementarities among different technologies. According to the Director of Darfur Peace and Development's Solar Cooker Project "There should not be any real comparison of the solar cooker and the wood stove. They are partners not competitors. When there is sufficient sun, use the solar oven. When you don't have a sunny day, use the wood stove. If it is night or evening and you must cook then a solar oven will not work. Both types of stoves when used together will reduce the consumption of fuel." (Email correspondence, May 6, 2008).

Several alternative market models emerge. ITDG/Practical Action focuses on the user of the stoves (Darfuri women cooking for their households). By promoting awareness about fuel efficiency and alternative stove technologies, ITDG/Practical Action encourages users to build both production skills and consumer acumen. CHF focuses on the supply of stoves by channelling investments to a plant to produce metal stoves locally and experimenting with selling the stoves at different price points (albeit all below production costs). CHF's then partner, the Berkeley Lab, emphasizes the technology. "We are on to Version-11 ('V11'); different from V5 in that it: comes as an "Ikea" style flat-kit of pre-cut sheet-metal; can be built entirely with hand tools without electricity; has internal insulation, and has built in protection against wrong assembly" (Gadgil, 2008). The Berkeley Lab seeks to fund production cost externally and experiments with new models of leasing and distribution (Abdelnour and Branzei, 2008).

When CHF and the Berkeley Lab amicably dissolve their partnership in the summer of 2008, CHF efforts shift towards greater involvement of the consumer and greater engagement of groups representing the users and buyers of fuel efficient stoves in Darfur. On September 25, 2007, CHF facilitates a participatory workshop with Women's Commission for Refugee Women and Children for 30 internally displaced women from all three El Fashir-area camps (Abu Shouk, As Salaam and Zam Zam) on the subject of FES. The workshop takes place at the offices of the UN Office for the Coordination of Humanitarian Affairs (OCHA) in partnership with the Women's Commission/International Rescue Committee (IRC).

The growing plurality of development interventions increases users' awareness of fuel efficiency and enables greater discretion in their consumption choices. However, this plurality also distorts the supply of stoves by subsidizing production runs on stove designs which continue to rely on non-indigenous materials. Externally funded distribution programs disconnect supply from demand through production subsidies which keep prices artificially low, often handing out the stoves for free. By 2007, multiple designs are available at different price points (Appendix A). Production costs range from US$1–27, with prices from US$1–22.5. Most stoves sold and bought continue to be heavily subsidized — for example, the BDS costs as much as $27 to produce but is sold for as little as US$7 (Branzei and Abdelnour, 2008).

By 2008, the subsistence market for FES becomes increasingly active and more and more fragmented. Despite continuing debates about the efficiency of the mud stove, supply and demand for this technology continues to grow. So does demand for brick stoves: International Lifeline Fund (Lifeline) distributes the “magic stove” for as little as US$1; Aprovecho contracts with a Chinese factory to import and sell a version of the “Rocket” at a similar price (Table 1). CHF and their partners continue to aggressively promote metal models; their interventions have supply rapidly outpacing demand for metal stoves, even at (still) heavily subsidized prices. A partnership between JWW with Solar Cookers International raises over $1 million to outfit over 300,000 households with solar stoves at a price of $15 per stove, estimating 2 stoves per household. Solar models are distributed for free and used alongside mud and/or metal stoves.

5. A staged model of social construction of subsistence marketplaces

Discourse analysis suggests that subsistence markets for FES in Darfur progresses through three distinct, sequential stages: the first stage focuses on the direct health benefits of the technology; the second stage grapples with the indirect benefits to women IDP, whose exposure to violence may decrease as fuel efficient stoves limit their trips outside the camp; the third stage explores ways to build an economy in Darfur by deliberately (re)structuring market roles and exchanges of FES. All three stages focus on women in Darfuri camps, but emphasize different needs: health in stage 1, protection against violence in stage 2, and empowerment as market participants in stage 3. The labels for these three stages were “The Killer in the

Kitchen" (introduced by ITDG/Practical Action), "Reduce Risk of Rape" (embraced early on by USAID and legitimated by the UN in 2005), and "Building an Economy in Darfur" (emphasized since 2006 by new FES protagonists seeking to establish their complementarity to ongoing efforts). Three key events punctuate the transitions among these stages: the 2002 World Summit acknowledges the risk of smoke inhalation; the 2005 UN Interagency report recommends FES as a rape risk reduction measure; and the 2008 USAID FES Evaluation report recognizes the emergence of a subsistence marketplace. Protagonists repeatedly cross-reference these three events. Although their own micro-discourses evolve more gradually, both in anticipation of and in response to these changes in macro-discourse, all the development organizations in the study refer to these events as the critical milestones in the evolution of FES projects in Darfur. The respondents also explain how each event triggers alternative patterns for producing, distribution and selling FES to target users. Before elaborating on these patterns, two clarifications are in order. First, these events represent shared milestones: they apply both to local and international organizations. Second, the high visibility of the shifts in macro-discourse and their influence on subsequent funding priorities motivates protagonists to adjust their own micro-discourses and to selectively reference these macro-discourses. Some embrace these changes fully or partially; others contest the new themes and reference their prior positions in contrast to the anticipated changes.

Table 2 provides several examples of the interlacing discourses of global donors and the development organizations active in Darfur between 1997 and 2008, as the subsistence marketplace for FES takes shape through discursive action and reactions across the three stages. Excerpts from texts describing the development interventions in each stage show how development organizations collaborate and compete over the best way to help women in Darfur. Some participants seek to empower Darfuri women in spite of trade-offs in efficiency and income gains (e.g. ITDG/Practical Action), while others seek to protect women's well being even if the interventions has the Darfuri women increasingly dependent on outsiders and imported technologies (JWW, Lifeline).

Insert Table 2 Here

Table 3 presents the staged social construction of the subsistence marketplace for FES in Darfur by unpacking the construction of who would benefit from development interventions. The target beneficiaries are construed in ways that mitigate health-risk, reduce rape-risk, or promote fuller engagement in market transactions. The development of subsistence marketplaces is further shaped by strategic use of discourse to motivate development interventions, i.e. explaining why donors should attend to the needs of women IDPs in Darfuri camps. Their reasons shift from arguments to reduce death risk due to smoke inhalation, to pleas to reduce rape risk due to time spent on wood harvesting trips, to claims about time savings that enabled gainful engagement in rebuilding the economy. Development organizations also outline what they would do to address the needs of women in

Darfur, such as "empowering women by reducing the time, effort, risks and expenses involved in collecting, chopping and using fuelwood" (UNDP, 2002: 5), giving women a choice to not venture outside the camps (USAID, 2007b) and infusing income and market skills through the production and commercialization of stoves (Darfur Stoves Project, 2007). The analyses further explain how development organizations set out to influence the emergence of subsistence marketplaces for FES in Darfur. Specifically, in stage 1 development interventions help women using the stoves become aware of the benefits of improved fuel efficiency. In stage 2, FES projects seek to change the habits of women, as users, producers and buyers of stoves and fuel in ways that keep them safer. In stage 3 development organizations take greater interest in grassroots models that empower women and facilitate their engagement in market transactions, often in the multiple roles of producer, distributor, or consumer of fuel-efficient stoves.

Insert Table 3 Here

5.1. Stage 1: "The Killer in the Kitchen"

Stage 1 positions FES interventions as a way to improve the lives of women and children by reducing the health toll of smoke inhalation due to inefficient stoves. ITDG/Practical Action description of this intervention makes repeated reference to the 2002 World Summit on Sustainable Development in Johannesburg (August 26–September 4, 2002), specifically the Global Partnership for Clean Indoor Air then launched by ITDG/Practical Action along with UN partners and the World Health Organization (WHO). The partnership aspires "to reducing the mortality related to indoor air pollution in targeted areas by 50%" (Partnership for Clean Indoor Air, 2007). ITDG Smoke and Health Report up-plays the intersection between WHO's macro-discourse linking FES with health hazards (claimed to kill more than three people each minute worldwide, Table 3) and ITDG's micro-discourse which articulates the health benefits accruing to the women working in the kitchen and their children.

By May 2004, ITDG/Practical Action starts the first "Smoke and Health Project" in Darfur: it introduces a Liquid Petroleum Gas (LPG) stove and begins transferring some best practices from similar projects in Kenya and Tanzania to Sudan. ITDG reports the introduction of LPG stoves to 167 households; they distribute 112 more and enlist demand for another 137 (ITDG Sudan, 2005). International organizations endorse these early indoor air pollution efforts with links to gender-based violence in Darfur (WHO/UNDP, 2004). Several years later, more than 80 development organizations adopt the WHO macro-discourse and reference ITDG's early LPG intervention to motivate FES interventions in developing countries.

Few stoves are sold in Stage 1. At $10 each, LPG stoves are too expensive for most target users and a subsistence market for LPG stoves never emerge in Darfur. However, the women who use the LPG stoves become increasingly aware of the importance of fuel efficiency. Most stoves are made by their users, from mud and

using simple designs (Appendix A). ITDG offers basic skills in manufacturing mud stoves using locally available and affordable materials. This enables users to become producers, creating local supply and demand for FES.

5.2. Stage 2: "Reduce Risk of Rape"

The 2005 UN inter-agency report calling for the promotion of FES "on a massive scale", in an attempt to stem the attacks against displaced women, ushers in a second stage of social construction of FES subsistence marketplaces. This second stage is anchored by a shared objective to mitigate rape-associated risk for women IDPs in Darfur. Starting in 2004, USAID actively promotes FES as a rape risk-reduction intervention. This macro-discourse enhances emerging micro-discourses by several Darfur-based INGOs. CHF International launches into Darfur post-crisis to run a nine-month fuel efficient stove program funded by USAID (September 28, 2004 to June 28, 2005). The final program report states that "fuel efficient stove production was intended […] to reduce fuel consumption and female exposure to violence and rape while collecting firewood" (CHF, 2005: 8).

The "Reduce Risk of Rape" mandate takes prominence among Darfur-based interventions. JWW, for example, estimate that 90% of rape in Darfur is associated with trips for collecting firewood outside the camps (Table 3). By 2005, two out of three significant FES interventions in Darfur with displaced women involve CHF: one in Zam Zam camp and another (a joint project with ITDG) in Abu Shouk camp. By 2007 USAID reports the training of over 50,000 women in Darfur. Refugees International's 2005 bulletin, titled Sudan: Rapidly Expand the Use of Fuel Efficient Stoves in Darfur argues that, "By reducing the need for wood and emission of smoke, a switch to simple, more fuel-efficient stoves could ease environmental stress and improve health, while reducing the time women spend collecting wood, a task that exposes them to the risk of rape and other forms of gender-based violence" (Wolf, 2005: 1). Interventions focus on reducing trips outside the camp by changing the cooking habits of Darfuri women through promoting the use of (more) fuel efficient stoves (Table 3). A subsistence market for FES begins to emerge; although the majority of stoves are still handed out for free, more community members get involved in producing and distributing mud stoves (Appendix A).

5.3. Stage 3: "Building an Economy in Darfur"

In late 2004, the Berkeley Lab partners with CHF International and starts working on FES design as part of a USAID-funded project (Fig. 1). The stated goal emphasizes the efficiency gains stemming from better design. The Berkeley Lab hastens to single out ITDG's mud stove as "the worst performer, using almost 90% of the fuel that the 3 stones fire consumed and emitting significantly more smoke" (Practical Action Sudan, 2007: 1), a claim contingent on a handful of field tests. The focus on efficiency resonates with Aprovecho, which after completing a more comprehensive assessment of the FES in Darfur between August 29 and September 16, 2005 in partnership with the International Lifeline Fund, argues that ITDG's "basic stove has

reportedly resulted in a reduction in wood and charcoal consumption of approximately thirty to fifty percent [...] Nevertheless, for all local variations of the ITDG model, the fuel efficiency rate "can be improved up to 70% savings, a rate already achieved in the IDP camps in Northern Uganda" (Aprovecho, 2005: 10, 15). ITDG/Practical Action Sudan discourses rebut these direct attacks claiming an average of 50% savings and accusing the Berkeley Lab of inadequate research and invalid comparisons (Practical Action Sudan, 2007: 2).

New entrants take advantage of growing interest from women IDPs and international donors to promote complementary offerings. The new stove designs, often handed out for free, focus either on technology (e.g. JWW partners with Solar Cookers International and Darfur Peace and Development to promote solar cookers), users (e.g. WCRWC starts representing the interests of women IDPs as informed users of fuel efficient stoves), or a combination of users and technology (e.g. International Lifeline Fund's introduction of brick stoves encourages consumers by increasing stove efficiency and affordability).

Taken together, these three stages show how a subsistence marketplace for fuel efficient stoves can be socially constructed in post-conflict settings through ongoing, interlacing conversations between global fora and local and international development organizations. Interventions in stage 1 promote the localized production of FES by Darfur-based stove users. Interventions in stage 2 enable users to take on new market roles by participating in the design, manufacturing and distribution of increasingly sophisticated models of FES in Darfur but fall short of scaling up stove buying and stove selling by Darfuri IDP. Furthermore, market roles remain somewhat disjointed because development interventions in this second stage often attend to users' need by increasing the supply of stoves. Interventions in stage 3 seek to stimulate market exchanges by helping users take on a consumer role. As these users are gaining awareness of the standalone and comparative fuel savings, stove life spans, and social and economic benefits for different stove models they gradually emerge as central market participants. By 2007, their choices increase the popularity and the demand for specific FES models. Women's engagement also accelerates the emergence of a subsistence market for specific models, by driving down their price and stepping in to fill market intermediation roles.

By the end of 2008, the subsistence market for fuel efficient stoves builds momentum, engaging over 52% of the Darfuri communities in market transactions for FES. As market participants gain voice and influence, a subsistence market emerges around the more affordable stove models (the mud/clay stoves and the brick models — the Rocket and the magic stoves). Selling for a few dollars and lasting up to 36 months, these fuel efficient stoves meet women's needs and emergent consumer preferences (Branzei and Abdelnour, 2008). Reports by several development organizations suggest that, by 2008, 90% of FES owners use mud models; 49% of the women who own both mud and metal stoves prefer the mud stoves. Although market transactions still represent a small fraction of the stoves

being used, the emancipation of Darfuri women as active participants in the production, distribution and especially the consumption of fuel-efficient stoves motivates new efforts by development organizations to keep driving down the cost (Appendix A).

5.4. Enabled and emergent market transactions

By unpacking the corroborating and contradictory micro-discourses of development organizations promoting FES in Darfur, the findings begin to demystify why some development interventions successfully enable subsistence marketplaces while others delay or distort them. Table 4 illustrates their positive and negative outcomes across discursive stages.

Insert Table 4 Here

In stage 1, development organizations construe FES as a means to combat "The Killer in the Kitchen". By reducing smoke inhalation, interventions imbue stove users with specific skills associated with the use and local production of stoves. A train-the-trainer model where women learn to manufacture their own stoves by relying on inexpensive local materials and then train others to do the same helps encourage market transactions in several ways: keeping costs affordable (less than $1 per unit), empowering women to take on new roles as artisans that manufacture and could promote and sell the stoves themselves, thus recalibrating supply and demand as FES gained popularity among the Darfuri women. Post-hoc assessments show that several other roles stem from these FES interventions. Some interventions also have unanticipated effects. For example, subsidies to adopters (to fund training, materials, or production costs) initially distort the supply of stoves and the expectations of users. However, early interventions under-represent the voice of consumers and fail to model the emerging demand for FES. This raises questions about their sustainability and scalability.

In stage 2, FES interventions focus on reducing the risk of rape by cutting down the number of trips outside camps (Table 3). Controversy ensues about the acclaimed success of these interventions in changing wood collection habits among Darfuri women. USAID reports in 2005 that the number of trips was cut at least twofold, from near daily to only 2 or 3 times per week (Table 4). Later reports suggest that women continue to take risks in order to earn additional income on the secondary market for firewood; some reports even suggest that the time savings might have fueled the growth of this secondary market (Abdelnour and Branzei, 2008). These interventions enable some stove buying and selling in the local markets. As thousands of women are trained in the production and use of various models, several new roles emerge. Women learn by doing, then take a lead in training others; women groups come to mobilize and monitor exchanges of FES stoves (Table 4). Development interventions scale up from 31% of the Darfuri communities to 52% — yet they still only cover half of the communities in need. Their limited geographic coverage delays the evolution of subsistence marketplaces for FES in the

remaining communities, which continue to rely on the traditional three-stone fire, despite global recognition of health risks and low fuel efficiency.

In stage 3, field reports suggest that mud stoves continue to gain popularity, and at least 80% of the IDPs owning a mud stove use it frequently. However, because multiple interventions often target the same consumers, some have several idle stoves, while others receive none. Efforts to bring together supply and demand by subsidizing costs with the goal of scaling up local stove production delay or distort the emergence of local exchanges. Consumers grow expectant of charity, and increasingly critical of the new designs in spite of their continuously improving efficiency (Abdelnour and Branzei, 2008). Experiments with alternative market transactions, such as Berkeley Lab's proposal to rent the stove at about 50 cents a week temporarily tilt the pricing structure. Stoves become available at prices ranging from $1 to $27 a piece; yet most users can opt to manufacture their own FES for about $3 or wait for new programs to hand out free stoves or introduce new technologies (Branzei and Abdelnour, 2008). Despite the fitful progress in structuring FES exchanges, consumers gradually gain market experience and take increasingly active stakes in the emergent marketplace — often by fulfilling overlapping roles and responsibilities as producers and distributors. Many of their skills in producing and commercializing FES are beneficial to other market transactions (Table 4).

These findings offer at least two practical implications. First, development interventions are necessary but not sufficient in the aftermath of conflict of crises — development organizations can discursively (re)construct market participants and promote specific transactions, but their efforts are a double-edged sword. Because such interventions are often a first step towards restoring self-sufficiency in post-conflict settings, unpacking their influence on the early development of subsistence marketplaces is critically important. This study suggests that development interventions may under- or misrepresent the voice of consumers in ways that delay or distort the emergence of market transactions.

Second, the analyses underscore the need to monitor and recalibrate development interventions to the evolving and idiosyncratic needs of their beneficiaries. Most development organizations heed shifting funding priorities, and adjust their discourses strategically — and these changes pattern their actions. This study shows that development organizations deliberately draw attention to specific beneficiaries, advocate specific reasons for interventions, target specific areas of impact and take specific actions. Taken together these stimulate some market roles and transactions while shortchanging others. In so doing, development interventions may at times engender more vibrant economic exchanges while at other times they may delay or distort the emergence of subsistence marketplaces by favoring either the supply or the demand side, or promoting divergence or convergence between supply and demand.

The silver lining is that collectively these interventions gradually affirm new market roles and transactions on which subsistence marketplaces can start to flourish. Moving forward, the findings suggests that in order to fully understand the upsides and downsides of developmental interventions in stimulating subsistence marketplaces (Cornwall and Brock, 2005) and accelerating post-conflict reconstruction (Fort and Schipani, 2004, Willams, 2008), understanding how supply meets consumers' is necessary but not sufficient. One needs to ask how development interventions help nurture more aware and more resilient consumers, how they can seed and stabilize emergent transactions, and how they can help (re)align fragmented roles in a way that helps demand keep pace with and (re)shape supply to meet evolving consumer expectations.

6. Contributions

The study explores the social (re)construction of subsistence marketplaces through development interventions. By unpacking discursive interplays among protagonists to tease apart the staged evolution of their target beneficiaries, reasons, focus and actions, the analyses shed new insights on the early emergence of subsistence marketplaces in post-conflict zones to show why development interventions are necessary, yet not sufficient. Prior studies suggested that subsistence consumers may be initially disadvantaged (Alwitt, 1995, Banerjee and Duflo, 2007), yet gradually build the skills and social resources necessary to sustain vibrant marketplaces (Sridharan and Viswanathan, 2008).

Notwithstanding the important role of development organizations in enabling market transactions that help generate social and economic value (Lewis and Opoku-Mensah, 2006, Teegen et al., 2004), little is known so far about the socially embedded mechanisms by which development interventions come to help or hinder the emergence of subsistence marketplaces (Cornwall and Brock, 2005). A critical approach that tracks the strategic and symbolic discourses of development organizations as they unfold show that development interventions gradually if somewhat fitfully stimulate the development of the supply and/or the demand side. Their interlacing actions and reactions propose, contest and validate market configurations by providing the means and the motivation of different market participants (designers, producers, sellers, distributors, consumers and users) to experiment with specific roles and transactions.

Appendices

Appendix A. Fuel efficient stove technology

Appendix A.1. Traditional three-stone fire

The most traditional way of cooking food in Darfur is on a wood fire built between three large stones. Pots are placed directly on the stones. For cooking the traditional Darfuri meal, an onion–oil stew (mulah) with millet porridge (assida), women typically use both a small (16–19 cm diameter) and large (23–28 cm diameter) round-bottomed pot.

Appendix A.2. Liquid Petroleum Gas (LPG)

LPG stoves are introduced to Darfur in 2003 as part of ITDG/Practical Action effort to reduce smoke inhalation. ITDG demonstrates several potential smoke reduction interventions — Liquid Petroleum Gas (LPG) burner, kerosene wick stove, and LPG kisra (flat bread) hot plate; they organize demonstrations and awareness sessions for women. The estimated cost of LPG stoves is $10; each stove generates savings of $150–200 for each disability-adjusted life year (DALY) (Practical Action, 2006). According to ITDG "In the end, all households in the project opted for LPG as the best smoke reduction because:

•It is locally produced and abundantly available.
•It is a clean-burning fuel, which doesn't leave soot deposits.
•It generates more heat for faster cooking than biomass fuel.
•The government has set incentives to encourage LPG use with subsidies of 50% and exemption of LPG appliances from import tax." (ITDG Sudan, 2005: 6).

Appendix A.3. Metal stoves

Most high-efficiency metal stoves can be traced back to the Tara stove, a multi-fuel, metal FES developed in India by Development Alternatives in 1980s. "The Tara stove is designed to work with flat-bottomed cooking pots that fit snugly into the stove body rather than the round-bottomed pots used in Darfur. As part of the stove design intended to work with a flat-bottomed pot, three metal pot support brackets are fastened around the top of the Tara stove body. The lower (L-shaped) part of each bracket supports the pot while the upper part ensures a small (~ 1.5 cm) gap between the pot perimeter and stove wall to allow flue gases to escape while improving heat transfer to the pot. When a large round-bottomed pot is placed on the Tara stove, it sits on top of the pot support brackets. This leaves an extended gap of approximately 6 cm between the pot and the stove body, allowing significant convective heat loss to occur during even a small breeze." (Amrose et al., 2008: 7).

The Berkeley Darfur Stove (BDS) is an adapted Tara design with two modifications to address convective heat loss via the extended gap: 1) the horizontal length of the

upper pot support brackets is reduced by 2 mm each, allowing a round-bottomed pot to sink slightly lower into the stove body; 2) the top of the stove body features an erected wind-shield to block high horizontal winds from the extended gap while still allowing flue gases to escape vertically; this also ensures good thermal performance for a variety of pot sizes (adapted from Amrose et al., 2008: 7–8). In 2004 The Berkeley Lab estimates that the BDS can be hand-built or mass produced in Sudan for $10; based on field tests, the report claims that the Berkeley Tara "will save about 70–75% of the fuelwood used by a three-stone fire" (Gadgil and Amrose, 2006: 28); Between May 2007 and July 2008, the Berkeley Lab produces metal stoves in collaboration with CHF, at costs ranging from US$20 to 22.5; about 70% of the stoves are distributed for free in eight camps; the balance is sold at prices from US$5 to 7.5 (Branzei and Abdelnour, 2008).

Appendix A.3.1. The Darfur Fuel Efficient Stove (DFES)

After an amicable parting of ways with the Berkeley Lab, CHF reports in a June–July 2008 report that the metal stoves can be produced for US$10–15; 225 stoves have been sold in two camps by the time of the report, and consumers indicate a willingness to purchase more if the price gets lower. The DFES has an estimated five-year span compared to only 6–36 months for a mud stove.

Appendix A.4. Mud stoves

Appendix A.4.1. Standard mud stove used in Darfur

ITDG/PA's mud stove in Darfur is a simpler version of the Kenyan Upesi stove. The stove is built using locally-available bricks and clay. The stove is designed to burn wood, although it can also burn crop waste such as maize stalks and cobs, and animal dung. The mud stove is designed for one pot, but two or more stoves can be installed side by side so that the cook can use more than one pot. The walls of the stove are built around three bricks to a thickness of approximately 4 cm. Flush with the top of the bricks, the thick walls of the mud stove can support a range of commonly used pots, with round and flat bottoms. However, it is unsuitable for very small pots or very wide ones (Source: Practical Action Sudan, 2007). Mud stoves continue to be locally produced for US$1–3.

Appendix A.4.2. The Avi stove

Named after Mr. Avi Hakim, CHF International Nyala staff, The Avi stove follows the standard ITDG mud stove design as promoted in Darfur IDP camps, with one retrofit proposed by Dr. Ashok Gadgil. The Avi features a cast iron grate (bought in India for approximately US$0.50) placed over an opening cut out of the bottom. When this stove is set upon three bricks that lift it off the ground, air flows to the solid fuelwood, substantially improving combustion efficiency. The grate can also be made from pieces of locally available 0.5 cm diameter steel rod, cut into 18 cm lengths, costing approximately the same. The grate improves combustion efficiency and reduces smoke generation. The new design also includes vertical ventilation

channels carved into the inner walls of the stove and three mud knobs added to the top to permit combustion air flow even when a tight-fitting large pot or a flat metal plate is being used for cooking (adapted from Galitsky et al., 2006, p. 10–11). By July 23, 2008, CHF distributes 10 times the number of Avi clay stoves compared with metal stoves (the Berkeley Darfur Stove, then the Darfur Fuel Efficient Stove). In 2008, the Avi stoves are priced at US$8 but their life-span is estimated to also be five times shorter than the Darfur FES (Branzei and Abdelnour, 2008).

Appendix A.5. Brick stoves

Appendix A.5.1. The Rocket

"The rocket stove costs just $3 to make and can reduce firewood consumption by up to 75 percent" (USAID, 2007a: 6). Developed with the technical input of the Aprovecho Research Center, the Rocket is a six-brick stove made out of local clay mixed with rice husks (which provides insulating properties), molded into specially-shaped bricks, and fired with wood logs using traditional clamp kilns. The brickmakers bind the fired bricks together in clusters of six using thick wire. One brick is cut in half to make an opening for feeding fuel. This basic stove body can be installed in a kitchen by fixing it upright to the ground and plastering it with mud. Women can choose to build up thicker stove walls if they want greater strength and stability. Mass production of the bricks helps ensure uniform sizes and shapes, maintaining each stove's combustion chamber dimensions. Pots rest on three small stones placed at the top of the stove to allow for improved air circulation (adapted from USAID, 2007c: 14–15).

Appendix A.5.2. The magic stove

In mid-2006, International Lifeline Fund introduces the "magic stove" — a design which maximized efficiency through the use of an insulated combustion chamber built out of lightweight bricks made from a mixture of clay and other organic materials, such as rice husk or groundnut shells. Lifeline's "magic stove" is in fact the same Rocket — with the new catchy label, reportedly given by the users themselves (Branzei and Abdelnour, 2008). Two years later, "Lifeline has managed stove programs at three separate sites in North Darfur (Al Salaam, Kebkabiyah and Tawillah). These programs have produced some 10,000 fuel-efficient stoves, which have profoundly improved the lives of some 50,000 displaced women. In addition, Lifeline has helped two other NGOs start their own "rocket stove" programs, which have so far provided stoves and associated trading to an additional 5000 women in both North Darfur (Shengal Tobayi) and West Darfur (Kereink)." (International Lifeline Fund, 2009).

Appendix A.6. Solar stoves

In 2007 Solar Cooker International introduces "a sun-powered cooker, made of cardboard and aluminum foil, at a cost of $15 each" to several camps of Darfuri

refugees; SCI estimates that each family needs two solar cookers. By March 2008, when the project receives the $100,000 Charles Bronfman prize, SCI fundraises $1 million to fund the free distribution of the solar cookers (Tugend, 2008).

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Table 1 Market protagonists and fuel efficient stove milestones in Darfur

	Focus	FES technology
ITDG/PA	The Intermediate Technology Development Group (ITDG) was founded in 1966. In 2005, ITDG changed its name and brand to Practical Action (PA). Its approach is people-centric, engaging community members as partners in technology projects so that they shape and control technology for themselves.	1997–2008 Introduces mud stoves 1997–2005 Provides training support for all Darfur-based FES interventions 2003–2005 LPG stove project
CHF	The Cooperative Housing Foundation (now known as CHF International) was established in 1952 as a catalyst for long-lasting positive change. CHF now works in the areas of disaster relief, environmental management, infrastructure rehabilitation, economic development, civil society development, and post-conflict response.	2006 Partners with the Berkeley Lab to produce metal stoves (Berkeley Darfur Stoves, BDS) 2007 Funds Nyala plant to produce BSD 2008 Introduces Darfur FES (DFES)
USAID	Founded in 1961, and now active in over 100 countries, the U.S. Agency for International Development (USAID) has five goals: supporting transformational development, strengthening fragile states, supporting U.S. geostrategic interests, addressing transnational problems, and providing humanitarian relief.	2004 Indirectly promotes metal stove interventions by supporting CHF launch in Sudan 2007 Endorses the Rocket stove
Berkeley Lab	Founded in 1931 by Noble Laureate Ernest Orlando Lawrence, the Lawrence Berkeley National Laboratory (Berkeley Lab) has been a leader in science and engineering research for more than 70 years. Its Environmental Energy Technologies Division performs analysis, research and development leading to better energy technologies and reduction of adverse energy-related environmental impacts.	2004–2008 Designs efficiency improvements to the ITDG mud stove (the Avi models) 2006 Berkeley Darfur Stoves Assessment Report promotes metal stoves (BDS) based on superior efficiency
Lifeline	International Lifeline Fund (Lifeline) aspires to make every one of its dollars count by eliminating waste, promoting cost-effective technologies and emphasizing appropriate interventions, which give needy individuals the tools and wherewithal they require to lift themselves out of poverty and become more productive members of their societies.	Mid-2006–2008 Promotes brick stoves — rocket stoves and magic Stove models (approximately 10,000 stoves distributed in Darfur)
Aprovecho	Aprovecho Research Center is a US-based non-profit organization dedicated to creating effective and widely usable appropriate technology solutions to problems, e.g. cooking and heating with biomass (wood, charcoal, dung, and crop residue).	2005 Darfur Humanitarian Stove Project Assessment promotes brick stove technology
WCRWC	The Women's Commission for Refugee Women and Children (WCRWC) is an independent affiliate of the International Rescue Committee (IRC) founded in 1989. It serves as a watchdog and an expert resource, offering solutions and providing technical assistance.	2008 CHF and WCRWC workshop promotes metal stoves (DFES) and mud stove (Avi models)
JWW	A member of the Save Darfur Coalition, Jewish World Watch (JWW) was established in October 2004 as a Jewish response to horrors perpetrated by human beings against others. In addition to education and advocacy, JWW's refugee relief projects alleviate the suffering of survivors and victims of genocide.	2006 Solar Oven Project with KoZon Foundation and Solar Cookers International (SCI) introduces solar cookers to Darfuri camps

Figure 1 Fuel efficient stove development interventions in Darfur

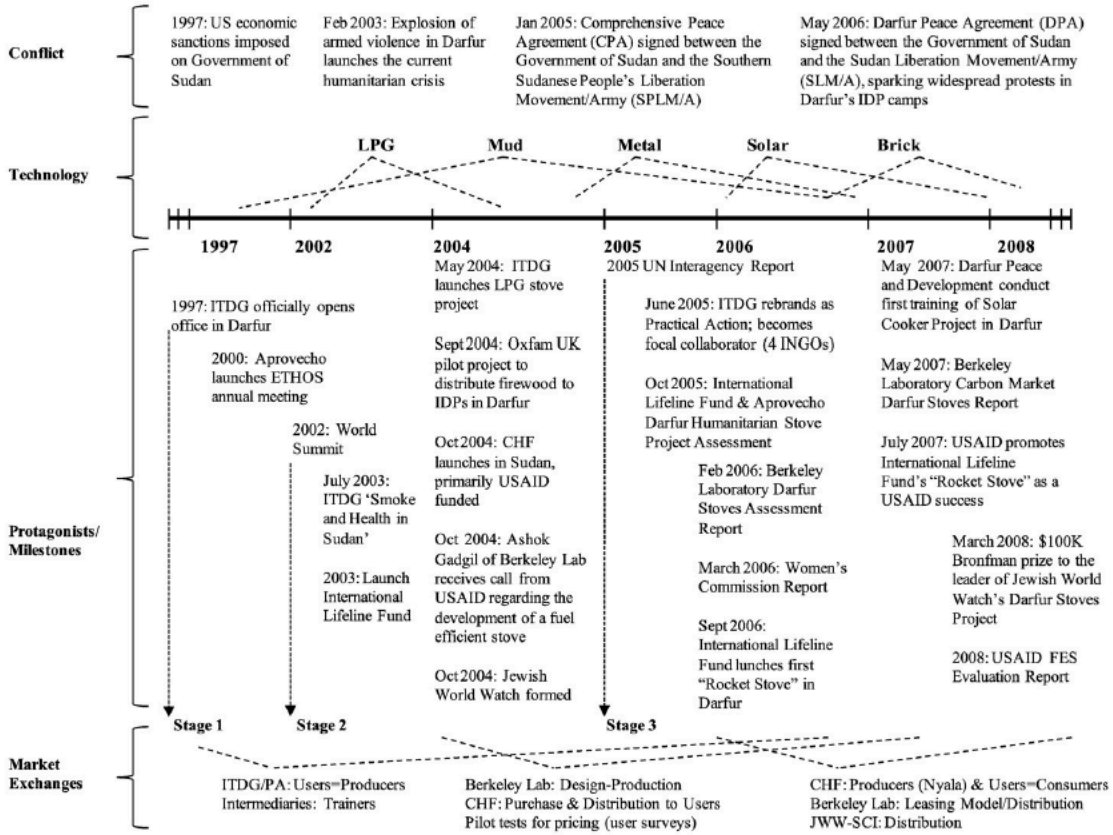

Table 2 Who benefits? Macro and micro discourses

1997		2002 World summit	2005 UN interagency report	2008 USAID FES evaluation report
		Stage 1: "The Killer in the Kitchen"	Stage 2: "Reduce Risk of Rape"	Stage 3: "Building an Economy"
Macro-discourses	Examples	"The most visible impact of the fuel-efficient stove is related to improved kitchen management, hygiene improvement, and savings in fuel wood, time and effort as well as improved social relationships." (UNDP, 2002: 6)	"FES programs are critical […] for reducing their vulnerability to gender-based violence during trips outside the camps to collect fuelwood." (USAID, 2006a: 2)	"The "rocket" stove, designed by the International Lifeline Fund […] costs just $3 to make and can reduce firewood consumption by up to 75 percent." (USAID, 2007a: 6)
	Texts	ITDG/Practical Action report Killer in the Kitchen: Indoor Air Pollution in Developing Countries (2004); The Working Group on Climate Change and Development (June 2005, Oct 2006)	USAID report (Sept 2006); Oxfam Magazine (2005); Refugees International Bulletin (October 2005) WCRWC report (Feb 2006) FAO/USG report (May 2007)	USAID Darfur FES report (Dec 2008) USAID report (2006); USAID Energy Update (2007); Aprovecho report (Jan 2008) CHF, 2007 Annual Report (March 2008) WCRWC conference (Dec 2008)
Micro-discourses	Example	"Smoke in the home is one of the world's leading child killers, claiming nearly one million children's lives each year." (Warwick and Doig, 2004: 6)	"The risk of rape and mutilation for those who collect fuelwood would be reduced by three-quarters." (Amrose et al., 2008: 4)	"Monetary savings of US $222 per family per year for IDPs who buy fuel wood or a savings of 18 hours of labor effort per week for IDPs who currently collect fuel wood." (Amrose et al., 2008: 4)
	Texts	Darfur stoves, http://darfurstoves.lbl.gov/ CHF Program Reports (April 2005, Sept 2005); CHF press release (July 2005); CHF project report (Dec 2005)	Berkeley Lab report (Feb 2006, May 2006, May 2007); Reuters (Aug 2007); CHF Program Report (March 2006, May 2007)	SCI-DPAD workshop report (June 2007) JWW evaluation report (Oct 2007) CHF information sheets (Oct 2007, Feb 2008); CHF project presentation (May 2008)
Interlacing discourses	Examples	"Today, nearly every NGO engaged in protection runs fuel-efficiency programmes" (Pantuliano and O'Callaghan, 2006); "Over 80 organizations are working together to increase the use of clean, reliable, affordable, efficient, and safe home cooking practices that reduce people's exposure to indoor air pollution in developing countries." (Bryden et al., 2005)	"Protection is a growing field. More and more agencies are interested in protection and are viewing it as part of their role. […] Fuel-efficient stoves reduce the need to venture into unsafe areas to secure cooking fuel, reduce fire hazards, generate livelihoods, and create logistical savings." (USAID, 2004, November: 43, 66)	"Most implementing agencies don't even consider FES as a project, but as an activity line within their normal projects. In the best situation, FES is considered as a sub-project within a main project like livelihood support. […] In more than 80 per cent of FES-related projects…implementing agencies merely start all over again, ignoring the lessons of the previous Implementers." (Stone et al., 2008: 2, 3)
	Texts	nef: Africa — Up in smoke?: Report of The Working Group on Climate Change and Development (June 2005); Barbara Grovers's Darfur FES Documentary	"Sexual violence and firewood collection in Darfur" in Forced Migration Review (Patrick, 2007)	Alternative Fuels Take Root in Refugee Camps (Dec. 2008); Jewish visionary awarded Bronfman Prize for helping Darfur women, YnetNews.com, (March 2008)

Table 3 The social construction of development interventions in subsistence marketplaces: why, why, what, how?

	Stage 1: "The Killer in the Kitchen"	Stage 2: "Reduce Risk of Rape"	Stage 3: "Building an Economy"
Who	"Prolonged exposure to biomass smoke is a significant cause of health problems, including acute respiratory infections (ARI) in children, chronic obstructive lung diseases such as asthma and chronic bronchitis, lung cancer and pregnancy-related problems. […] ITDG Sudan's Smoke and Health Project is the first of its kind in addressing these issues." (ITDG Sudan, 2003: 4)	"All IDPs are affected by violence, but the needs of women and girls affected and threatened by rape and gender-based violence stand out. Many attacks take place when women — putting themselves at risk of attack, rather than their husbands and sons, who might be killed – are collecting firewood outside the camps." (UK HOC, 2005: 28)	"To date, 10,000 families living in crowded camps have received fuel-efficient clay stoves produced by IDP women who have been trained and provided with jobs in production of the stoves" (CHF, 2007: 2)
Why	"More than a third of humanity, 2.4 billion people, burn biomass (wood, crop residues, charcoal and dung) for cooking and heating. [...] The smoke from burning these fuels turns kitchens in the world's poorest countries into death traps. Indoor air pollution from the burning of solid fuels kills over 1.6 million people, predominately women and children, each year. This is more than three people per minute." (Warwick and Doig, 2004: 6)	"Inasmuch as 90% of the rapes of the women in Darfur occur while the women are foraging for firewood outside of the camps." (JWW, 2006: 4) "A switch to simple, more fuel-efficient stoves could [reduce] the time women spend collecting wood, a task that exposes them to the risk of rape and other forms of gender-based violence." (Wolf, 2005: 1)	"The stove provides an estimated average savings of $160 year per household, a significant amount of money in Sudan, where per capita income is $640/yr. [...] time currently spent collecting fuelwood (over 7 hours per day) can be spent on other income-generating activities." (Booker et al., 2007: 3)
What	"By improving the efficiency of the wood burning stove, the amount of toxic smoke produced can be reduced and health risk to the family minimised. Improved stoves can provide a number of benefits by saving energy, reducing indoor air pollution, increasing household saving capacity and empowering women by reducing the time, effort, risks and expenses involved in collecting, chopping and using fuel wood." (UNDP, 2002: 5)	"Venturing from the relative safety of the camp increases a woman's chance of harassment and abuse, yet those who decide not to leave the confines of the camps have little choice but to spend a portion of their family's income or food rations on firewood at the local markets." (USAID, 2007a: 5)	"Annual output of this factory will provide $30 million to the Darfur refugees in avoided fuel wood cost, or income earned from other remunerative activities, and also help the local and global environment." (The Darfur Stoves Project, 2007: 24)
How	"More time spent collecting fuel can mean less time growing or preparing food so that quality and quantity of food diminish. Malnourished women become more vulnerable to smoke pollution which damage their lungs, eyes, children and unborn babies. But improved stoves can cook faster and burn fuel more efficiently, which lowers levels of exposure to biomass smoke and releases time for other activities." (ITDG, 2005: 9)	"The terrible human rights and humanitarian crisis that has displaced some two million Darfur villagers has ironically provided the international community with a unique opportunity to assist them in a way that can have a positive, permanent and profound effect on their livelihoods." (Wolf, 2005: 2)	"The program approach differed from organization to organization and from region to region. Some organizations used indigenous materials [...] while others imported materials abroad for their stoves. Some organizations made the stoves and distributed them." (Martin, 2007: 22)

Table 4 The emergence of subsistence marketplaces for fuel efficient stoves in Darfur

		Stage 1: "The Killer in the Kitchen"	Stage 2: "Reduce Risk of Rape"	Stage 3: "Building an Economy"
Development intervention effects	Positive	"FES programs can produce stoves at a cost of about one dollar per unit, most of which goes toward training since they are made entirely from inexpensive indigenous organic materials." (Wolf, 2005: 2)	"Participants reported that the previous need for near-daily fuel wood collection has been reduced to two to three times per week." (USAID, 2005a: 2)	"There is widespread support for a fuel-efficient stove initiative. The improved mud stove has the highest uptake so far —80–99% of the people targeted by the FES projects, use them frequently" (Cole and Wroe-Street, 2008)
	Negative	"Many of the improved stove projects across the world have had limited success, even with subsidies to the adopters." (UNDP, 2002: 5); "Overemphasis on technology, without concurrent work on behavioral change, market access and health impacts, resulted in limited results and unsustainability of many projects." (USAID, 2005b: 7)	"The United Nations Population Fund reported that in 2006, FES programs were available in 52 percent of sites (communities and camps) throughout Darfur, up from 31 percent in 2005. The humanitarian community sponsors trainings and distribution campaigns of FES to IDPs living in camps and host communities." (USAID, 2006a:)	"The use of FES has resulted in targeted beneficiaries using between 40 to 80 percent less fuel for cooking food. This translates into many fewer trips needed to gather wood for cooking, but has not necessarily resulted in less time devoted to fuel collection, because women will make extra trips to collect wood to make money for household and personal needs." (USAID, 2006a:)
Subsistence marketplace transactions	Enabled	"The community is actively involved in the manufacture and promotion of stoves, which are sold commercially on the open market. [...] The annual production is estimated at 10,000 to 11,000 stoves, and the profit generated by the stoves provides artisans with a higher than average rural wage. As a result, the women involved have gained status, self confidence and financial independence." (ITDG, 2001: 9)	"To date, Oxfam-UK has trained 6000 IDP women in manufacture and use of the three stove models developed, and some are now selling stoves in the local markets." (USAID, 2005a: 2)	"They won't be handing the stoves out as charity — "Giving something away turns the recipients into beggars," Gadgil says— but at $25 apiece, the devices are out of the reach of most families. Gadgil favors some sort of leasing plan, allowing families to rent the stove for about 50 cents a week. The ultimate goal is for the refugees to take over the program, from manufacturing to distribution, which would mean jobs and income." (Sheridan, 2007)
	Emergent	"A scaling-up strategy was developed with the Women's Development Associations (WDAs) and other partners and stakeholders. This enabled women to buy ovens and gas cylinders by establishing a revolving fund, managed by the women who also contributed to it financially. The Gas Agent in Kassala agreed to supply cylinders on an instalment basis." (Practical Action Sudan, 2005)	"Women's groups have been offering support in mobilising and monitoring participation at the camp and community levels. This role has necessitated the discovery of new leaders from among the women. Through 'learning by doing' a lot of the women are now able to train others to produce stoves and they can apply these skills in other disciplines." (Stone et al., 2008: 3)	"Fuel-efficient stoves are manufactured in camps for less than $3 using local materials, including clay, sorghum stems, dung, aluminum, and water." (USAID, 2006b: 3) "More market-based accountability needs to be introduced to the stove distribution process — entrepreneurs should be encouraged." (Hood, 2008: 17)

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