

Framing Resource-Constrained Innovation at the 'Bottom of the Pyramid': Insights from an ethnographic case study in rural Bangladesh

ABSTRACT

Resource constrained-innovation at the so-called 'Bottom of the Pyramid' (BOP) in developing countries has attracted the attention of a growing number of scholars, who present different and sometimes conflicting narratives within which such innovation is framed. These variously frame innovation as supporting the opening up of new markets in the BOP (the 'poor as consumers') where multi-national companies are key actors, or grassroots, indigenous innovation aimed primarily at social and environmental goals, such as inclusion, empowerment and sustainability. These narratives are however largely theoretical in nature, with only limited empirical evidence from the field. We present the results of an ethnographic study in rural Bangladesh in which we explored the framing and dynamics of resource constrained innovation. We found that rather than following any one particular narrative presented in the literature, innovation framings merge and co-exist through a process of hybridisation. Our research suggests that further empirical study of such processes of hybridisation in the field could be valuable for understanding resource-constrained innovation and associated social change at the BOP. This may have broader relevance for a world where resource constraint may become an increasingly ubiquitous phenomenon.

Keywords: Innovation, Bottom of the Pyramid, developing countries, innovation narratives, hybrid framings, dynamics.

1 INTRODUCTION

Intriguing and provocative concepts such as 'frugal innovation' (Bound & Thornton, 2012), 'reverse innovation' (Govindarajan & Trimble, 2012), 'Jugaad innovation' (Radjou, Prabhu, Ahuja, & Roberts, 2012), 'BOP¹ innovation' (Prahalad, 2010, 2012), 'Gandhian innovation' (Prahalad & Mashelkar, 2010), 'empathetic innovation'(Gupta, 2010, 2012), 'long tail and long tailoring' innovation (Anderson & Markides, 2007), 'below-the-radar innovation' (Kaplinsky, 2011) and 'inclusive innovation' (George et al., 2012) have attracted the attention of a growing number of scholars around the world. These forms of innovation are characterised by conditions of material, financial and human resource scarcity (Baker & Nelson, 2005; Gibbert, Hoegl, and Valikangas, 2006; Keupp & Gassmann, 2013), resource insecurity and concerns regarding environmental sustainability (Sharma & Iyer, 2012): they can be considered under a general umbrella term (Rip & Voß, 2013) of 'resource-constrained innovation' (RCI). Their focus has been in general on emerging and developing countries and, specifically: RCI's role in the global value chain (Kaplinsky, 2000), its potential to open up unexploited markets (Prahalad, 2010) and the emergence of indigenous, grassroots forms of innovation (A. Smith, Fressoli, & Thomas, 2014). This heterogeneous literature is focused on the resolution of three major questions: first, does innovation occur (and if so how) in resource-constrained environments such as those found in many parts of the developing world i.e. a focus on process (Keupp & Gassmann, 2013)? Second, how does innovation contribute to various goals such

¹ The notion 'Bottom of the Pyramid (BOP)' usually indicates those nominally living on less than 2 US dollars a month (Prahalad, 2010).

as social inclusion and poverty alleviation (George et al., 2012; Hall, Matos, Sheehan, & Silvestre, 2012; Halme, Lindeman, & Linna, 2012), and/or the creation of markets for commercial gain? i.e. a focus on the normative basis for innovation, its purposes and underlying motivations. Third, what are the implications for the so-called developed world, i.e. 'innovation blowback' (e.g. South-North transfer) acknowledging the globalisation of resource scarcity as a feature of modernity - and in turn what are the implications for emerging innovation policy? i.e. a focus on implications, policy and even risks.

As regards the first question, there is a broader literature concerned with organisational capacities for innovation involving 'making do with what is at hand' (e.g. Baker & Nelson, 2005; Garud & Karnøe, 2003). Other studies identify within the bounded creativity of teams the inception of RCI (Hoegl, Gibbert, & Mazursky, 2008) and stress the mutual interaction between science-based Research & Development and experience-based learning (Hendry & Harborne, 2011). Others have focused on popular ingenuity and 'frugal innovativeness' (Gupta et al., 2003; Radjou et al., 2012).

The academic literature concerning the second question suggests a plurality of framings in terms of goals, purposes and motivations. Innovation scholars in both emerging and developing countries have for example advocated the need for functional innovation systems aimed at overcoming problems of underdevelopment and poverty (Arocena & Sutz, 2000; Lundvall, Vang, & Chaminade, 2009; Martins & Cassiolato, 2008; Muchie & Gammeltoft, 2003). Others have argued that innovation can in fact be the *very cause* of inequality and social exclusion (Arocena & Senker, 2003; Arocena & Sutz, 2003; Cozzens & Kaplinsky, 2009; Cozzens, 2007, 2008). Some entrepreneurship and organization scholars have focussed on the possible opportunities innovation may present for opening up markets at the BOP through the development of 'good-enough' and affordable products (London, 2009; Prahalad & Mashelkar, 2010). These scholars hypothesise that the BOP could be a source of breakthrough innovations (Prahalad, 2012) and offer a huge potential market for multinational corporations (London & Hart, 2004; London, 2009). In contrast again, others focus on indigenous forms of RCI carried out in informal settings by grassroots movements, often in response to local issues such as social injustice or environmental problems (Smith et al., 2013), with an emphasis on patterns of innovation and development that are appropriate for the poor in the developing world (Abrol, 2005; Dagnino, 2009; Gupta et al., 2003).

Finally as regards the third question, there is increasing interest in the broader potential for and real impact of RCIs emerging from the Global South. The Nation Health Service (NHS) in the UK is for instance considering low cost Indian innovations in healthcare (NHS, 2013). Hart (2002; 2011) has suggested that a new wave of 'green disrupting innovations' is about to flood the North. Others (e.g. Brown, 2005) warn against the blow-back effects of Southern innovations on the North's competitiveness and argue for the advantages that 'reverse innovation' could bring to emergent economies like India and China (Govindarajan and Trimble (2012)).

The academic literature presents then a variety of narratives for RCI at the BOP: but these are largely conceptual and theoretical in nature. In our research we aimed, through a field study in rural Bangladesh, to empirically describe the dynamics and framings of RCI from direct observations in the field, comparing these with the narratives presented in the literature.

The paper is set out as follows: firstly we describe how RCI narratives and framings have emerged from the academic literature i.e. some theoretical foundations. We then empirically explore, through a mixed methods approach based on observational ethnography how RCI framings are embodied in practices in a case study in rural Bangladesh. Finally we discuss our empirical findings and its limitations within the context of the extant literature, leading us to suggest that innovation in resource constrained environments such as Bangladesh occurs at the intersection of a complex network of actors and power relationships with multiple, overlapping framings, rather than following any one narrative presented in the literature. Such narratives in the real world are not mutually exclusive, but co-exist and are, at the same time, the subject of tensions and contradictions (Stirling, 2011): they are pluralistic, recombinant and hybrid. Understanding the social construction of such

hybrid innovation narratives we argue may be useful to understand RCI and social change in at least parts of the developing world, and may also present novel innovation and innovation policy opportunities as yet little explored in the global North.

2 THEORETICAL FOUNDATIONS

While innovation has been proposed as a fundamental ingredient for development (Dosi & Freeman, 1988; Jan Fagerberg, Srholec, & Verspagen, 2010; Freeman & Soete, 1997) how it emerges and diffuses under conditions of resource constraint within developing countries is relatively under researched in the academic literature (Lundvall, Vang, & Chaminade, 2009). This literature presents a series of narratives which frame RCI in variously ways: for example, contributing to the process of 'catching-up' e.g. (Fu, Pietrobelli, & Soete, 2011; Kim, 1980), or the building up of innovation systems e.g. (Arocena & Sutz, 2000; Cassiolato, Lastres, & Maciel, 2003; Lundvall, Vang, & Chaminade, 2009; Lundvall, Vang, Joseph, & Chaminade, 2009; Muchie & Gammeltoft, 2003) or 'pro-poor or from the poor' innovation (e.g. Gupta, 2012; Hall et al., 2012). These narratives emerge from differing values, interests, world views, power relationships, and experiences (Demeritt et al., 2011; Leach, Scoones, & Stirling, 2010) which in turn present tensions and contradictions (Pansera, 2013).

One well known and influential RCI narrative was first introduced by Prahalad in 2005 (Pralhad, 2010), who argued that the poor are un-served consumers who represent an immense market currently underexploited due to perceptions of their very limited purchasing power. By targeting the poor, the private sector could have access to new and unsaturated markets and the poor in turn would gain access to consumer goods that are currently inaccessible due to cost. In order to appeal to those at the BOP, new products and services have to be designed and innovated 'to do more with less and for more people' (Pralhad & Mashelkar, 2010; Prahalad, 2010, 2012). According to these authors, Multinational Companies (MNCs) are best placed to implement such a strategy (Kanter, 2008). The profit goal is not the only motivation in this narrative, which emphasises a central role for MNCs in eradicating poverty through the co-production of economic profit and social value underpinned by a free market economy and western style democracy (London & Hart, 2004; London, 2009).

This narrative intersects with a branch of the entrepreneurship literature that focuses on the Levy-Strauss notion of *bricolage* (Lévi-Strauss, 1966) where one must 'refuse to conceive scarcity as a limit' (Baker & Nelson, 2005). On the contrary, in this narrative scarcity is considered a starting point to ignite a process of innovation in which there is recombination of pre-existing knowledge, often through the development, amendment and adaptation of technologies, products and processes, and social and managerial practices, all of which are appropriate for the BOP context in which they are to be deployed (Gibbert, Hoegl, and Valikangas, 2006; Immelt, Govindarajan, & Trimble, 2009; Zeschky, Widenmayer, & Gassmann, 2011): there are an increasing number of examples of the *bricolage* activity of MNCs in emerging countries such as India and China in this regard (Immelt et al., 2009). Other authors (e.g. London & Hart, 2004; London & Anupindi (2011) Ramachandran, Pant, & Pani, 2012; Viswanathan & Sridharan, 2012; Weidner, Rosa, & Viswanathan, 2010) have updated this narrative by suggesting successful initiatives at the BOP require a strong commitment to establishing 'BOP alliances' and participatory ventures with local actors and institutions, with the aim of creating legitimation among beneficiaries and create '*innovation eco-systems of support for inclusive innovation and social entrepreneurship*' (Sonne, 2012).

These narratives, which spring largely from entrepreneurship and management studies disciplines and which advocate a framing of innovation aimed at eradicating poverty through market based mechanisms, underscored by consumption and a profit motivation (Christensen, Craig, & Hart, 2001; Hart & Christensen, 2002; London & Hart, 2004; Prahalad, 2010) have been the subject of

extensive critique. Critics include those who assert that such framings neglect environmental issues (Pitta, Guesalaga, & Marshall, 2008), that they present a romanticised view of the poor and that they 'grossly underemphasize the critical role and responsibility of the state in poverty reduction' (Karnani, 2009). They also include those who claim that a development discourse based on market-based approaches and technology transfer reflects and promotes post-colonial aspirations and asymmetric power relationships that exist between north and south (Escobar, 1984, 2000, 2012), critical feminist groups who claim more attention should be given to gender empowerment and equality issues (Karnani, 2007a, 2007b, 2011) and those (e.g. Kolk et al. (2006)) who argue that in order to improve their condition, the poor must be included in the production process instead of being turned into consumers.

Consumption-based narratives have also been opposed by social movements (Abrol, 2005), grassroots movements (A. Smith et al., 2014) and many Non-Governmental Organisations (NGO) (Hopwood, Mellor, & O'Brien, 2005; A. Smith, 2005) who call for a quite different vision and practice of innovation (Dagnino, 2009; Illich, 1973; Schumacher, 1973) aimed at empowering local communities and enhancing the indigenous, rather than MNC, potential to innovate (Seyfang & Haxeltine, 2012). Concepts such as grassroots innovation that stems from the poor to the poor (Gupta (2012)) may emerge for similar reasons that compel MNCs to engage with concepts such as bricolage (e.g. weak institutions, lack of infrastructure and lack of human, financial and other resources), but they embody quite different motivations. In these narratives indigenous grassroots innovators aim to address problems that are *essentially and primarily social* (Smith, 2005), refuting the essentialist idea that poverty is caused by a direct lack of income and consumption potential. Poverty rather involves, on one hand, the inability to have access to the basic benefits of a market economy (De Soto, 2003) and on the other the lack of essential capabilities that enable freedom to access better opportunities (Sen, 1999). Thus, it is not surprising that such innovation is empathetic (Gupta, 2010) or pursues objectives other than consumption, profitability or ever increasing incomes (Ansari et al., 2012). Grassroots narratives acknowledge technology and innovation are neither socially or politically neutral (Winner, 1980) nor sufficient to overcome the problems of poverty, social exclusion (Burnett, Senker, & Walker, 2010) and global justice (Papaioannou, 2011). These are also reflected in concepts such as 'inclusive innovation' (Altenburg, 2009; Nijhof, Fisscher, & Looise, 2002; George et al, 2012) which advocates for a more equal and fair distribution of the economic benefits of innovation and economic growth, evoking concepts of social justice and equity.

In total the literature presents a set of tantalising narratives and framings for RCI that involve a spectrum of actors (from MNCs to NGOs, CSO's and grassroots innovators in local communities) and which are underpinned by a variety of goals and motivations that variously encompass profit, social, cultural, political and environmental dimensions. Framings in the literature are characterised by plurality and interpretive flexibility. There is however only little empirical understanding of the framing and dynamics of RCI *on the ground* (George et al., 2012). We favour the idea that 'technological innovation is a contextual process whose relevance should be assessed depending on the socio-economic condition it is embedded in' (Srinivas & Sutz, 2008). Insufficient efforts have been dedicated to understand empirically, how such narratives are reflected in the real world, and whether certain narratives have become, or are emerging, as dominant and powerful at the expense of others. In a world of exponential population growth in which resource constraint and resource insecurity may well become the norm, understanding such narratives and framings from both a theoretical *and* empirical perspective is important. We hypothesise that RCI is more likely to emerge from the intersection of multiple narratives, creating hybrid perspectives that catalyse contradictions and tensions in the process of their deployment. In order to test this hypothesis, in the following sections we present results of empirical, qualitative research in a case study of RCI in rural Bangladesh.

3 RESEARCH DESIGN AND METHODS

Qualitative methods have usually been selected for research at the BOP (Sánchez et al., 2005). A wide range of observational approaches that use inductive logic, often based on case studies, have been considered to be a more appropriate approach for this environment (Lee, 1999; Oosterlaken, 2011). These enable the researcher to uncover and explore relationships in complex environments, disclosing the influence of the social and cultural context upon the unit of analysis (Shah & Corley, 2006; M. L. Smith & Seward, 2009). Reflecting this philosophy, we have employed a method based on an ethnographic mode of enquiry using non-participant observation (van Maanen, 1988), reflexivity analysis (Czarniawska, 2007; Ortner, 1984), and micro-ethnography techniques (Neyland, 2008).

3.1 Research Setting of Case Study

Bangladesh has been depicted as a country with “dysfunctional politics and a stunted private sector” but one with surprisingly good development indicators when compared with its neighbours (the Economist, 2012). Bangladeshis enjoy a life expectancy four years longer than Indians, despite the Indian being, on average, twice as wealthy (World Bank, 2013). These advancements are not a mere result of economic growth: according to financial figures, Bangladesh remains a poor country with a GDP per capita of US\$1,900. Bangladesh has benefited from the extraordinary work of the NGO sector (Lewis, 2011), which exhibits a strong indigenous character and has been fundamental to the discovery of grassroots-level solutions to tackle poverty. Reflecting this, Bangladesh has recently been portrayed as a laboratory of innovative solutions for the developing world (Belt, 2011). Bangladesh presents a privileged opportunity to study how RCI is framed, emerges and diffuses, since it contains many of the key attributes – e.g. resource scarcity and insecurity, political instability, infrastructural weakness and institutional diversity/voids - that RCI in its various framings (see above) seeks to address (Zahra et al., 2009).

We have focused our study on Grameen Shakti (GS), which today is a branch of the Grameen Bank and is configured as a social enterprise dedicated to the innovation and diffusion of renewable energy technology for the rural Bangladeshi population. This includes a very successful range of Solar Home Systems (SHS), a promising technology to produce biogas and a popular programme of Improved Cooking Stoves (ICS) (Wimmer, 2012).

3.1 Data Sources, collection and analysis

The fieldwork was carried out in Bangladesh over 5 consecutive weeks between October and November 2012 and was divided into three parts (see Table 1). The first part was conducted at GS’s headquarters in Dhaka where interviews were conducted with chief executives, project managers, human resources managers and engineers. Data were collected in this phase via semi-structured interviews, photography and internal documents. All interviews in Dhaka were carried out in English and transcribed verbatim. The questions aimed to uncover RCI narratives and framings following three major lines of inquiry: the innovation goals, processes and dynamics within the company, the cognitive process underling the relationships between the company and its clients/users and the social and ecological impact of the company in the field. GS’s branches in the departments of Chittagong, Rajshahi and Natore were then visited. All the interviews were carried out in Bangla by way of an accompanying interpreter and then translated into English. Finally, GS personnel were also accompanied during their activity in the field. Their activities were observed, including SHS installations, promotion and sales, as well as Biogas demonstration and ICS technical services and repairs, complemented by interactions and discussions with users and their families. In order to reduce the bias introduced by language barriers, the interviews were later transcribed verbatim by an independent person, native in Bangla, who was asked to double check the correct interpretation of the initial translation.

Table 1 Summary of methods used in the case study

| Methods | Data collected | Concepts studied and induced |
|--|--|--|
| Observations | Observations of group meetings, SHS installations, promotion activities, instalments collections, repair services (field notes). | Norms, values, routines, organizational capabilities, collective practices |
| Semi-structured interviews with GS executives | 9 interviews | Strategy, corporate values, goals and motivations |
| Semi-structured interviews with GS engineers | 6 interviews | Innovation strategy, sources and purpose, capability building process |
| Semi-structured interviews with GS branch managers | 4 interviews | Fieldwork strategy, purpose and routines |
| Semi-structured interviews with clients | 22 interviews | Motivations, needs and lifestyle |
| Focus group with GS field workers | 1 focus group (taped and transcribed) | Fieldwork routines and practices, purposes and values |
| Filmed semi-structured interviews with Grameen Technology Centre women-technicians | 2 video interviews | Gender involvement, capability building |
| Documentary evidence | Internal reserved and public documents, newspapers articles and websites links | Organizational strategy, communication and legitimization of narratives |

The data collected were subsequently analysed with the aid of NVivo 9 software, which is widely used to analyse heterogeneous qualitative datasets (Miles & Huberman, 1994). Qualitative data were analysed through a process of iteration, contextualised within an emerging structure of theoretical reasoning. The data were first coded with a set of keywords that emerged from the data and which were chosen following a practice-based epistemological approach (Rennstam & Ashcraft, 2013) based on four main questions: (i) What are the practitioners doing? (ii) How do their values and purposes shape their practices? (iii) How do external factors relate to and influence these practices? (iv) How are narratives constructed in the process? First order codes were constructed in this way around two initial constructs (Leach et al., 2010): *Subjective judgements* and *external dynamics* (see Figure 1 for a detailed list of first order codes). The first order codes were then grouped in 9 thematic, second order constructs (van de Ven, 2007) and finally aggregated into 4 aggregate theoretical dimensions: i.e. *Innovation process, the 'green' narrative, working institutional weaknesses and creating social value*.

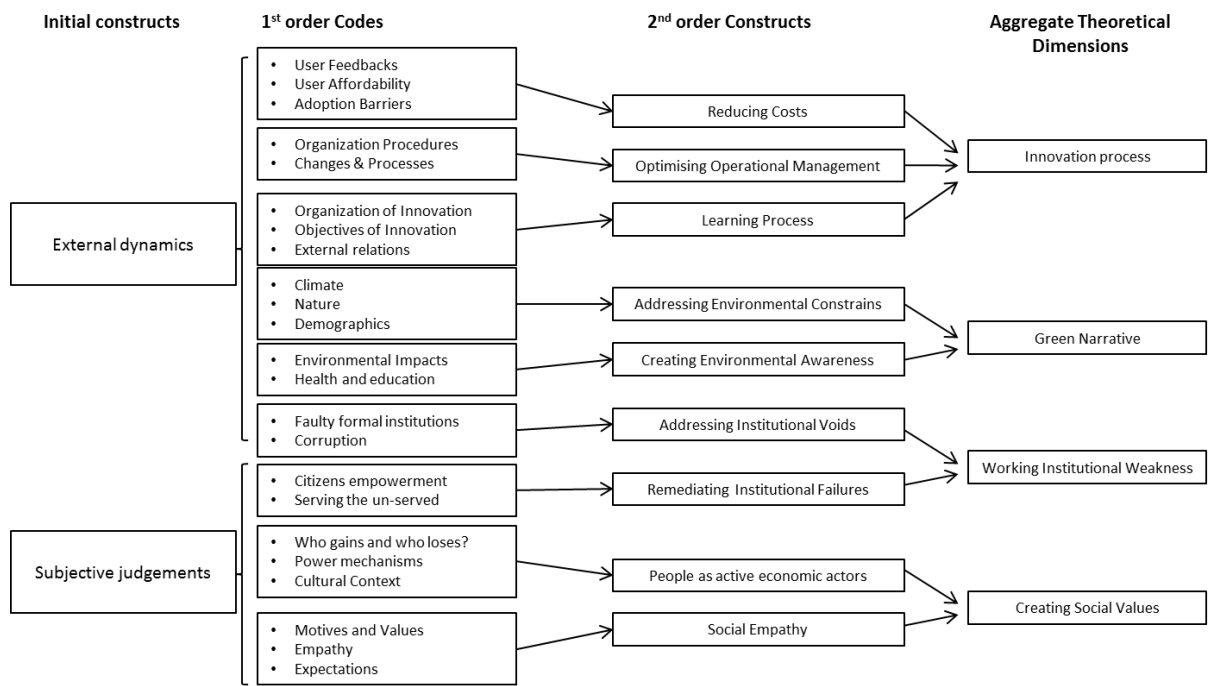


Figure 1 Analytical coding process to induce theoretical dimensions

4 RESULTS

The activity of GS is influenced by a complex network of actors and includes both informal (e.g. religious values and village-based, community habits) and formal institutional elements (e.g. government and international donors): this network is located in the broader context of a largely informal economy that characterises the ambient environment for clients of GS's services. The evidence that emerges from the data suggests that GS innovation activities can be described according to four theoretical dimensions (or frames) illustrated in Figure 1. The next section describes GS and these frames in more detail.

4.1 Context: Grameen Bank (GB) and Grameen Shakti (GS)

It is estimated that by 2011 44% of the rural and urban Bangladeshi population had been connected to electricity (Mondal, Denich, & Mezher, 2012). By the beginning of 2013 GS claimed to have installed approximately 1 million SHS across the country (Grameen Shakti, 2013). GS's second star innovation is the ICS, an adapted version of a traditional cooking stove that drastically reduces the presence of hazardous fumes in the kitchen. Another important innovation is the biogas plant: GS has developed a Biogas technology that can be used to transform organic wastes into biogas, fertiliser or slurry (Kamal, 2012).

GS started in the early 1990s as a spin-off of the well-known GB, founded by the Nobel laureate Prof. Muhammad Yunus (Yunus, 2010). Complete coverage of Bangladesh with a proper energy supply system has been always seen as a chimera for three main reasons. Firstly, Bangladesh is hindered by a lack of natural resources such as fossil fuels. Secondly, an endemic lack of financial capital has presented obstacles for necessary investments in new and more modern plants to assure stable energy production (Mondal et al., 2012). This is compounded by the wide geographical distribution of villages in rural Bangladesh, where dense urban clusters are rare and many places are almost inaccessible during the rainy season. Every year periodic floods erode the soil, destroying arable areas and accumulating sediment to create new land (van Schendel, 2010). This new land, which often takes the form of seasonal islands known as 'chars', is up to 90% more fertile than average and it is often the cause of conflicts (Lewis, 2011). It has been suggested that approximately

25% of the Bangladeshi population depend indirectly on the *chars* economy (Wimmer, 2012). As one GS field worker stated in an interview:

[...] the land is very fertile. People fight for the land. They keep guns with them, they kill each other. This is one of the dangerous places in Bangladesh.

All these factors challenge the deployment of a standard grid for power supply. The state is unable to address the overwhelming demand for energy, while the private sector is not attracted to supply sectors inhabited by extremely poor people who are not able to pay back infrastructure costs through their electricity bill. In June 1996 GB founded Grameen Shakti, which in Bangla translates as '*village energy*'. GS set up its first demonstration point with a 17W PV system and two lamps in a GB branch and a second one in the house of a borrower nearby. The first barrier to overcome was the prohibitive price of the solar panels, (approximately 13,000 Taka (US\$ 317) for a 17W panel in 1996). Since the average income of rural people was approximately 30,000 Taka (approximately US\$ 380) a year at that time, PV technology was for most an unreachable luxury. GS rooted its strategy in the GB business model, setting up an effective micro-credit scheme that turned the original non-profit company into a financially sustainable social enterprise within 4 years of its foundation. At the core of the GS business is a micro-credit mechanism that allows the repayment of a SHS, an ICS or a Biogas plant over two or three years of monthly instalments. Since 2001, GS has marketed its products in various configurations called *packages*. A package is a specific combination of components like PV panels and lamps combined with a repayment scheme. Packages are designed to address the huge diversity of GS clients and their differing capacity to pay. Similar schemes are applied to Biogas plants and ICS. In order to decrease the number of visits to clients to collect the monthly instalments (and consequently the operational costs), GS is currently developing a mobile payment application to allow the customers to pay with their mobile phone.

4.2. RCI frame 1: The Innovation Process Itself

The creation of RCI at GS has been, and continues to be mainly driven by financial and human resource scarcity. To overcome those constraints, GS has adopted three strategies: (i) cost reduction of final products, (ii) cost reduction of services through the optimisation of operational activities and service innovation (e.g. mobile payments) in the field and (iii) a process of learning that comes directly from the field. With no effective R&D department, innovation at GS is not planned but springs rather as a spontaneous, non-linear process of bricolage that is problem rather than consumption-driven. As a GS project development expert in Dhaka stated:

Grameen Shakti has a R&D department, but it seems it is in sleep mode. There is no particular division. [...] You cannot find the systemic R&D here. Everything is like more grassroots.

Hence, R&D in GS is a tacit, informal process based more on a process of trial and error that occurs at the boundaries between the company and the surrounding environment. In Bangla there is no proper translation of the English word 'innovation'. The field interpreter adopted the word '*unniti*', which can be roughly translated as '*change for good*'. As a consequence, the meaning of innovation in that context assumes a wider connotation that includes not only technological improvement but also more normative aspects. A Regional Manager described the most important innovation of GS as follows:

Solar [home systems] has been the biggest innovation for GS, as people in remote areas could not study and do their works due to absence of electricity.

A similar statement was very common among the senior staff at the company. The GS General Manager stated:

The real innovation of GS is to give very poor people the taste of light. Those people now have a better life and can improve their business. In the dark you can't walk or work.

In contrast, GS employees in the field appeared to have different priorities, privileging operational aspects:

We always provide after sales service. When a client reports a problem with the system, we immediately go over and solve the problem. So, we have been successful because our service is better than our competitors. (Field workers' focus group)

The innovation process in GS, at least in the initial stage, was observed to be driven by three factors: (i) the social need to provide affordable solutions, leveraging external providers to reduce product costs; (ii) to furnish an extremely flexible, quick and cheap after sales service, leveraging existing GB networks and (iii) further leveraging of a public system of incentives for rural electrification. The first challenge was addressed by redesigning existing technologies in a novel, frugal fashion (bricolage) and designing an innovative financial instrument that matches the limited income of rural people (i.e. micro – financing). The frugal re-design of pre-existing technology such as solar panels, biogas or traditional cooking stoves draws on *deskilling processes*, using local materials and local providers. Only the solar panel and the LED light bulbs are imported from abroad, with all remaining components being locally produced and assembled. Even the most complex component of the SHS, the charger controller, is designed to be easily repaired by local technicians that work in the Grameen Technology Centres (GTCs). The price is also kept low by the successful negotiation of good deals with those international providers of solar panels that often find it very useful to associate their brand to social business initiatives like GS. The scale of the activity and the caché of the Grameen brand have successfully convinced corporations within the solar industry to accept lower prices for their products.

The second challenge of providing an efficient after sales service to customers scattered across the country (and often in remote areas), has been addressed by exploiting the existing GB diffusion in the territory (e.g. 90% of GS managers come from GB). To this end an engineer at the headquarters in Dhaka stated:

Grameen Shakti is well known for its customer services. There are no major technical faults of the systems, and we provide substitute charge controllers to the users when they are faulty in place its place until we have fixed the faulty product. [...] the GTCs repair the faulty controllers and systems within a very short time.

The GS network in the rural areas also allows the testing and deployment of new solutions very quickly. The GS human resource director stated:

The logic is that as we have created a huge network all over the country, with 1,300 offices, we can introduce any new product and start disseminating it in the rural communities. When we started with solar, we thought of introducing biogas and ICS because we had the network, customers, and a good reputation. [...] The result is a reduced price of the system and an affordable after sales system for the users.

The technological know-how that is needed is imported from outside the company or created from the scratch. In the case of biogas for example, the initial know-how was introduced by local consultants who were trained in China where this technology has been known since the 1970s (Chen, Yang, Sweeney, & Feng, 2010). An engineer stated:

I was first introduced the Chinese model in 1992 and it was working very well. I learned from a man who went to China to learn about technology. I started disseminating the technology in Bangladesh and in 1994 I also visited China for training [...]. I received training for 2 months at a Chinese government-training centre [...]. Then 2 projects started with my initiative, and 28,000 plants were constructed.

The efficiency of the biogas plants has been increased over time by incremental improvements. The first model had many problems, being expensive, inefficient and with significant gas loss. The plant that GS currently installs is in contrast of a highly efficient concrete construction that is able to maintain the gas pressure at a constant level and produces good quality manure. This model was developed by GS consultants who had been experimenting for months on the roof of their houses. They ended up with a cheaper plant that does not lose gas and guarantees 6 hours of cooking a day. Biogas plants are diffusing quickly among small farmers and the potential for further expansion is promising.

Public infrastructures in Bangladesh are often inadequate and in the *chars* are virtually absent. Roads and paths are continuously swept away by water and deploying a proper energy supply network would be a challenge even for a cutting-edge Western company. GS sales in the *chars* are however soaring. The Rajshahi field work team knows the local market very well:

There is no chance of national grid connection, and the people knew this and buy Solar Home Systems. [...] The highest number of Solar Home Systems sold is in the Char. We have already installed more than 700 SHSs.[...] 95% of our work is done in the Char. [...]All the houses in these areas are temporary and they have to move every time the water level rises. [...]

GS found a profitable niche in the *chars* as the financial conditions of dwellers were found to be much better than expected. Many *chars*' dwellers market their products through the Indian border and have abundant harvests. Despite their uncertain living conditions, they can often afford a portable SHS to carry along in their nomadic existences. GS has even developed an *ad hoc* solution to introduce biogas in the *char*, which consists of a fiberglass digester that can be easily installed in the sandy soil and removed relatively quickly in case of flooding.

Finally, the GS operational costs are reduced by leveraging the public system of incentives for rural electrification programs promoted by the Infrastructure Development Company Development (IDCOL) (IDCOL, 2013). IDCOL is a non-bank financial institution leader in private sector energy and infrastructure financing in Bangladesh. IDCOL delivers loans that are payable in 8 years at a very convenient interest rate. GS business consists of borrowing money from IDCOL to cover the material and operational costs and recovering the money from clients within 2 or 3 years.

4.3 RCI frame 2: The green narrative

This frame was observed to draw on two elements: the need to overcome '*environmental constrains*' that affect the rural areas and the desire to create '*environmental awareness*'. Bangladesh is an over populated country where people mostly rely on local ecosystem services for their survival. GS executives claim that SHS, ICS and the biogas plants reduce pressures on local ecosystem services that traditionally have provided biomass for lighting and cooking. A rough estimation of the carbon emission reduction of GS activity based on the data released by the company on January 2013 alleges a saving of 920,000 tons of CO₂ per year ("Grameen Shakti," 2013). GS has started a program under the Clean Development Mechanism (CDM), the emission trading system defined in the Kyoto protocol (IPCC, 2007). In the words of one project manager:

[GS] it is the only company in the country registering for CDM in case of both SHS and ICS [...] So, developed countries are getting interested in CDM for buying carbon quotas. Grameen Shakti is the frontier in this regard in Bangladesh.

The main argument within the GS 'green narrative' is that RCIs are intrinsically eco-friendly because they aim to minimise the use of energy and raw materials not only in the development of the final outcome but also during the entire value chain. In the words of the GS chief engineer:

GS is contributing to global environment systems by reducing the emission of carbon in all its programs. [...] Through SHS we can save kerosene, while from ICS we can save wood biomass, and Biogas, which is a complete substitution of wood, and without biogas burner would otherwise need traditional biomass. In these ways GS is reducing global carbon emissions.

GS also claims that their activity is improving the environmental awareness of Bangladeshis in rural areas. They conduct educational programs and marketing activity in schools to promote their products and raise environmental awareness among young students. These activities have been crucial for penetrating the closeness of local communities. GS field workers use schools, community centres and local markets to illustrate the risks of using biomass for cooking and kerosene for lighting. The younger people within the community are usually the first to be enthusiastic about GS and convince their family to contract GS services. As a project manager in Dhaka stated:

GS started to conduct some school programs, awareness programs with the females. These school children later go to their homes and talk to their moms about the features of ICS. [...] After having listened the message from her children, then she gets interested in and joins the female workshops and fairs, got to know about it and then decide. This is the strategy.

4.4 RCI frame 3: Working Institutional Weakness

A fundamental pillar of GS's narrative is based on the institutional role they carry out within the country. This emerged from the data in two different ways: firstly, GS staff claimed to 'address institutional voids' (i.e. the incapacity of the state to deliver functioning energy infrastructure) and secondly, they argued that GS's model 'remediates institutional failures' (i.e. patronage relations, female segregation and social exclusion).

Formal institutions in Bangladesh are closely intertwined with a complex system of informal institutional elements that encompass social, religious and cultural practices. In the political domain, the institution of patronage is a dominant practice, not only within the State but also in the daily activity of the informal system of courts known as *shalish* (Lewis, 2011). Within patron-client networks, loyalty to the ruling group hampers any real investment in public activity other than its use to further interests of the party in power. Patronage, often accompanied by bribery, is the unofficial door to gain access to public jobs and justice. The asymmetric relationship between patrons and clients hinders any independent initiative and disheartens entrepreneurial activity (Mair, Marti, & Ventresca, 2012). Other social institutions that include the severe patrilineal system and other kinship norms of behaviour (e.g. the practice of concealing women from men known as *pardah*) limit the access of women to the public sphere. This is contrasted by cultural institutions such as the Islamic pre-emption laws (*shuf'a*) that imply a moral obligation to help the needy, encourage charity and civil society initiatives. By way of example, one GS employee in Podna described the Kafkaesque procedure to get access to public service in rural Bangladesh as follows:

In the local government, the Ward member is in the lowest position. [...] The local people elect the ward members by voting every 5 years. Each of the ward members represents 500 families and

informs the Union Council about their problems. They are in charge of road construction, and the wellbeing of the village. [If a village wants to claim for a public work] the Union Council passes it on to the UNO [the Upazila Nirbahi Office is the chief executive of an upazila (sub-district)] and thus to the District Council and Division Council, and finally to Dhaka. So if the appeal is positive it goes back to the ward members. It is a long and expensive process too. [...] A budget is allocated for the project, and divided accordingly in each of the levels. But the money is usually not enough to implement the project. There is corruption in every level, and the materials used are not of good quality [...].

A crucial asset of GS is its ability to fit into local social institutions without creating disruptive cultural clashes i.e. *working* institutional weakness. The GTCs are a good example of this process. Assemblage and service repair of SHS are carried out by female engineers distributed in 46 GTCs across the country. Allowing young female engineers to work in a safe and controlled environment constitutes a non-invasive format which can trigger a positive social change towards a more equal relationship between genders. Women in the GTCs work in a familiar environment, usually private houses where they share food and accommodation, and it is perceived as an excellent occupation. GS has observed that women perform better than men in technical tasks because they are more focused and patient.

Table illustrates the type of institutional void classified according to the 3 institutional pillars of Scott's taxonomy (2001) and the strategy deployed by GS to overcome them.

Table 2 Institutional voids vs. GS strategy. Adapted from (Mair & Marti, 2009)

| Domain | The pillars of institutions | | | GS Strategy |
|---------------------|---|--------------------------------------|---|--|
| | Regulative | Normative | Cognitive | |
| Political | Energy infrastructures policy and execution | Patronage and corruption | Asymmetric relationship between patrons and clients | Decentralised and distributed solutions User empowerment |
| Cultural and Social | Islamic juristic ruling (<i>Fatwa</i>) | Female segregation (<i>Purdah</i>) | Market exclusion for women and low access to work | Inclusion of women (e.g. GTCs) Innovative marketing strategy designed to address female domestic issues |
| Market | Unclear property rights (<i>chars</i>) Missing bank credit Profit uncertainty | Rural norms and rules | Rural exclusion | Flexible micro-credit schemes Efficient operational management |

4.4 RCI frame 4: Cultural empathy and the creation of social values

The micro-credit schemes and affordable prices of GS products explain only in part the wide diffusion of GS technologies. People at GS have a very clear idea of what the key to their success is: they succeed because *they understand the field*. The motives and interests of people determine how and why technology is adopted and inevitably shape its use and its evolution (Kaplan & Tripsas, 2008). The network of relations that intertwines technological possibilities, people's motives and the understanding of those possibilities constitutes a cognitive frame that shapes the socio-technical direction of an organization (Orlikowski & Gash, 1994). In the case of GS the cognitive frame is built around two basic elements: (i) a sense of social empathy and (ii) the persuasion that social values can be created by leveraging the capacity of people to perform as active economic actors.

The first element emerged in the data from the stated motivations of GS staff at different levels and with different intensity. The GS Operational Manager for example described why he joined the company in the first place:

The village I am from did not have power or electricity till I passed my university studies. I had to use kerosene lamps for my studies [...] I got chance to visit a very remote area in Bangladesh [...]. I helped him with the installation, and did not let him know that I was working for GS and was under the impression that I am a visitor. In the evening he asked all the children to come along with some adults too, saying that he would show them something magic. When a huge crowd had gathered he asked who was the youngest among them, and a 2 year old boy came forward whom he asked to turn on the switch for the light. Then all the lights were turned on and everyone started shouting in excitement to see light. Among the crowd there was a very old woman whom we asked if she had ever seen electricity or a switch on a light. She was afraid at first but after showing her how to switch on the light and turn it off, we saw the smile and happiness in the faces of the children and women. This was my motivation, and I thought that we should work to provide people with power as it brings happiness in their lives.

All the GS employees told a similar story. Coming from the same background as their customers, GS people share a very similar cognitive frame with those in the rural population. Field workers in local branches even share the same living conditions. They often live in isolated areas, use solar energy and are integrated members of the local community. They also share limited income with their customers because GS wages are intentionally maintained slightly under the market standards to encourage sales. The field worker knows the local ecosystem, family income, problems and aspirations.

The second element that constitutes the cognitive frame in GS is the idea that even the poorest people can perform well if one offers them the opportunity. This idea is borrowed from GB and permeates all the Grameen family organizations. The direct losers of the patron/client structure of Bangladeshi society are those people who are not strongly affiliated to influential groups of power or who are not members of any patronage. Living in such conditions creates limited access to basic services like water, education, healthcare and energy, based on power asymmetries. Even if one acknowledges that powerful NGOs or social business in Bangladesh act as quasi non-profit patrons, GS activity is likely to serve a wider group of people and in a more neutral way when compared to the traditional system of patronage. Unlike the traditional mechanism of power, the interest of GS is to sell as many products as possible to maintain business profitability and sustainability. As a consequence, at least in principle, the opportunity to purchase a SHS, an ICS or a biogas plant is not given on the basis of a specific clan membership but only on the basis of the capacity of people to pay back the loan with their work.

5 DISCUSSION: RESOURCE SCARCITY AND THE EVOLUTION OF HYBRID INNOVATION NARRATIVES

Our empirical evidence from Bangladesh suggests that stakeholders within the BOP environment there evolved a hybrid framing of resource-constrained innovation (e.g. leveraging market-based RCI narratives with concepts of empowerment, environmental sustainability and social inclusiveness more characteristic of grassroots RCI narratives), which were elaborated through a process of cultural bricolage that may at first appear paradoxical or contradictory in nature. This emerged due to a combination of factors that included resource scarcity, institutional weakness /voids and environmental constraints, combined with urgent social needs.

In the Bangladeshi case study GS was observed to construct its innovation process around resource constraint, which served as an important overall driver for innovation in terms of its purposes, motivations, dynamics and socio-cultural construction. GS's RCI innovation framing combines and embeds elements of multiple narratives described in the literature (see above), including those of frugal, grassroots and empathetic innovation, locating within a market based paradigm: i.e. RCI is framed by GS's mission as a social enterprise that is culturally empathetic,

environmentally sustainable and which creates social values. The observed hybridisation can be considered as 4 intertwined frames (see Figure 1) whose key elements include:

- (i) Minimum use of materials and energy: Local materials are preferred where it is possible.
- (ii) 'Good-enough' solutions: Products/services are deprived of all the unessential features that do not interfere with the main functionality.
- (iii) Deskilling processes: In order to minimise the need for a specialised labour force, those solutions must be simple to learn and easy to repair.
- (iv) Operational, service and management innovation: GS has to deploy and diffuse its solutions, including after sales support, at minimum cost.
- (v) Working institutional voids: GS draws on the failure of public and private sector to deliver reliable energy services.
- (vi) Leverage: existing GB networks, external providers, rural electrification schemes etc.
- (vii) Micro finance: GS assumes that the needs of low income people are better addressed by market financing mechanisms rather than charitable initiatives.
- (viii) Social value: GS considers that access to energy for rural people is essential for achieving social empowerment. This constitutes the very core of GS corporate values.
- (ix) Greening: environmental concerns are key values and drivers to attract investors and public support.
- (x) Empathy: the solutions are embedded in the local cultural context, although they often challenge established powerful habits like patronage.
- (xi) Finally and surprisingly, RCI as framed in this particular case study seems to embody values of modernity such as the right to energy or the right to health and good education.

RCI here is not framed simply as the innovation of affordable products or services by a MNC or entrepreneur aiming to create consumers at the BOP with the simultaneous co-creation of social value; nor on the other hand does it only imply grassroots 'from the poor, for the poor' social innovation. In the context it emerges, a process of hybridisation occurs whereby these narratives are combined and reconfigured to allow affordability, adaptability, social empowerment, sustainability and other values in a way that is appropriate for the context in which RCI occurs and which is pursued at different levels by a 'network of frugal actors' rather than a single entrepreneur (Bhatti & Ventresca, 2013; Iansiti & Levien, 2004)..

In this particular case institutional voids, which emerge from existing power structures and legacy institutions (Mair et al., 2012; Mair & Marti, 2009), were an important context for RCI. Such voids are filled by GS and its 'frugal network', drawing on the hybrid narratives described above. This evidence challenges the orthodoxy of institutional theory which argues that weak economic institutions, resources and infrastructure discourage innovation (Fagerberg & Srholec, 2008; Freeman, 1995). The evidence from this case study suggests rather that innovation, through a process of hybridisation can occur precisely under such circumstances. This in turn embodies specific political directions and creates tensions and frictions between new comers and incumbent actors (e.g. beneficiaries of patronage) whose dominant positions might be affected by the change.

One of the most important features witnessed during the research was the concept of "embeddedness" in the field. But, in the case of GS this 'closeness-to-the-poor', a key feature of grassroots narratives *coexists* with a market-oriented approach, in that GS uses market-based approaches to facilitate micro-financing packages, to attract international donors and to lever public incentive schemes. But at the same time its closeness-to-the-poor, empathetic framing allows access to rural communities, empowering and creating social value appropriate for the resource constrained context in which it operates, and legitimising its work. Rural communities in Bangladesh (and indeed more generally in the developing world) rely on reciprocal services that are very often based on non-monetary exchanges (Martinez-Alier, 2009): they are still embedded in what Illich

(1973, 2013) calls a convivial society where external influences may be received with a great deal of hostility. As a consequence, heterogeneity of the participants is one of the biggest obstacles to the diffusion of frugal and non-frugal innovation (Rogers, 1995). Empathy with locals, real or pretended, is crucial in those contexts where cognitive gaps between producers and consumers are likely to be wider (Fyvie & Ager, 1999).

6 CONCLUSIONS

One billion people live in the least developed countries and four billion people live in developing countries (Collier, 2007), often under conditions of resource scarcity. Globally, we face a future in which population growth is certain and resource scarcity and insecurity are likely to become increasingly ubiquitous. We suggest that empirical study of RCI in contexts such as the BOP is therefore important. The extant, largely theoretical and conceptual literature has framed RCI in several ways, but to date scant efforts have been dedicated to providing empirical evidence that sheds light on how RCI occurs and is framed in the field. The case study we investigated revealed a network of culturally-empathetic frugal actors who initiate the evolution of RCI that hybridised elements of narratives evident in the literature in a way that is appropriate to the context in which they emerge. In this case study, GS has framed its innovation activity around the merging of market-based narratives with social, grassroots and civic society elements. Our evidence confirms the idea that innovation occurs despite and maybe because of resource constraints (Srinivas & Sutz, 2008), here as a result of the combination of four factors: resource constraint, institutional weakness/voids, environmental motivations and strong social and cultural values such as empowerment. Our findings challenge approaches to innovation that privilege either, on one hand, the boosting of formal R&D programs, capital investments, and entrepreneurship or on the other, pure grassroots, low scale and appropriate technologies initiatives: neither are on their own sufficient to accurately characterise the innovation reality observed in the field.

While our research allowed us to gain insights into the complexity and richness of innovation framings and practices, its limited duration prevented us from developing a more longitudinal view. We are therefore currently undertaking further research in India in this regard and we recommend further case studies in order to better understand the extent to which such hybrid innovation framings are generalizable and to better understand the process of competence and capability building in such resource-constrained environments. It is important not to generalise from this one case study, and we suggest more empirical research should be conducted to understand better the emergence, dynamics and framing of locally-oriented hybrid innovation narratives in the face of resource scarcity, and go further to suggest this may offer new avenues for innovation policy discussions both in BOP contexts and beyond. In conclusion, our research suggests the need for a cultural politics underpinned by empirical understanding that takes seriously the co-existence and embedding of innovation framings from *both* the developed and developing world (Escobar, 2012).

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