**Are technological projects reducing social inequalities and improving people’s well-being? A capability approach analysis of renewable energy-based electrification projects in Cajamarca, Peru.**

**Álvaro Fernández-Baldor\*, Alejandra Boni\*, Pau Lillo\*\* and Andrés Hueso\***

\*Studies Group on Development, Universitat Politècnica de València, Valencia, Spain

\*\*Project Engineering, Engineering Without Borders, Valencia, Spain

July 2013 final version of a paper which was published in 2014 in the Journal of Human Development and Capabilities, 15 (1), 13-27.

**ABSTRACT**

This paper analyses four renewable energy-based electrification projects that were implemented by the non-governmental organization Practical Action in the rural area of Cajamarca, Peru. Using the capability approach, the research examines the effect of the projects on the things people value. It confirms that projects provide different benefits to the communities (reducing air pollution caused by candles and kerosene, improving access to communication through television and radio, providing the possibility of night study under appropriate light, etc.), but also detects an expansion of the capabilities in other areas not considered by the non-governmental organization such as those related to religion, leisure or community participation. However, the expansion of capabilities is different for men and women. The study reveals the limitations of interventions designed to supply technology, electrification in this particular case, which do not take into account certain elements that can make the use of technology contribute unequally to the expansion of people’s capabilities. The paper concludes that technological projects can generate inequalities, and some recommendations are presented in order to address these issues when planning interventions.

**KEYWORDS**: Off-grid electrification, Project planning, Capabilities, Gender, Peru

**1. Introduction**

Technological cooperation projects that provide goods or basic services to improve the well-being of people are generally welcomed by rural settlements. Who does not want to have a drinking wáter supply or electricity in their community? It is for this reason that donors, non-governmental organizations (NGOs) and other stakeholders in the International Development Cooperation System dedícate a considerable amount of their aid to basic infrastructure technological projects.

However, transferring the benefits of technology to society is not an easy task, especially in complex environments such as the least-developed areas of the world where there are many different considerations to be taken into account when planning a project. Development aid interventions have generally implemented technology strictly as a necessary tool for development. In practice, the projects focused on supplying technological assets or services. This is precisely their main limitation: focusing only on technology instead of focusing on people, thus missing the project’s potential for social transformation.

Instead, can we imagine technological development projects not only as a means to provide an asset or service, but also as a tool for helping people to shape their own lives and for reducing inequalities? This is the question we are trying to address in this article, analysing four technological interventions through the lens of the capability approach (CA). Specifically, the investigation looks at four renewable energy-based electrification projects in the rural area of Cajamarca in Peru. The four cases are off-grid projects with a communal management model and were implemented by the NGO Practical Action.

The article is organized as follows: firstly, we analyse the paradigms that have been framing technological intervention in the development sector, and particularly focus on those currently used by Practical Action in their projects, such as appropriate technologies and the sustainable livelihoods framework. Secondly, we analyse the contributions of the CA to technological interventions building upon these approaches. Then we present an ad hoc methodology for analysing rural electrification projects from the perspective of the CA. Lastly, we discuss the research results and suggest recommendations for the planning of development projects.

**2. The Need for People-centred Technology**

The first development projects within the framework of the International Cooperation System go back to the period prior to the Second World War. Productive investment, economic development and industrialization were at the centre of the debate and of the later process that would facilitate the transition from underdevelopment to development (Griffin 1991; Unceta 1996).

This vision of development as economic growth permeated and changed the methods of international cooperation: technology was progress, and progress should be transferred to underdeveloped countries to get them out of poverty. The objective was to take industrial development to places where it was absent (Griffin 1991). The projects were the main means for providing aid and they were designed top-down, giving priority to technological and infrastructure investment over other sectors (Robb 2004).

In the 1970 s the Appropriate Technology Movement (Herrera 1983) emerged as a result of the concern for environmental sustainability and the impact of the modernization and technology transfer model on the South. In fact, the origin of the Appropriate Technology concept goes back to Gandhi in colonial India (Motta 1996), who advocated a decentralized system of production, in opposition to the modernization imposed by the British Crown. But it was the economist E. F. Schumacher who introduced the concept in the western world. In his work, he proposed the economic and social development of rural areas to avoid mass migration to the cities, through the creation of small-scale industry: not too economically intensive, giving priority to employment opportunities over productivity, valuing the productive capacity of traditional sectors and not generating external dependencies through complexity (Schumacher 1973).

The implementation of Appropriate Technologies sought to address technological development by bringing back old or unused technologies, improving them where necessary. It implied the simplification of modern technologies, the adoption of appropriate technology used in other countries or the invention of new appropriate technologies. The objective of the interventions was to provide a technological solution adapted to a specific context that was also cheap and simple. The communities were meant to participate in the different phases of the project, but their role is confined to unskilled work, with the engineer as the person in charge of adapting the technology to the community.

The NGO Practical Action was created by E. F. Schumacher in the 1960 s and has been working ever since on Appropriate Technologies. However, Practical Action takes into consideration the debate about development and its complexity. For this reason it complements the use of Appropriate Technologies with other approaches and methods such as the sustainable livelihoods framework (SLF).

Chambers and Conway (1991, 6) defined livelihood as “[…] the capabilities, assets (stores, resources, claims and access) and activities required for a means of living.” The SLF suggests that family living strategies depend on a wide range of factors (human, social, political, economical, material and natural) where sustainability means the ability of the family to recover from adversity; their autonomy from external support; their resources productivity maintenance; and the absence of negative effects on their own or others’ means of living.

In the region of Cajamarca, Peru, the NGO Practical Action combines both approaches: the electrification projects are implemented using Appropriate Technologies (renewable energies, low cost, local production, simple technology, etc.) combined with the intention of supporting the livelihoods of rural families. However, as can be observed in our research, a weakness in the work of Practical Action in Peru is that they were focused on the implementation and management of the asset or technological service instead of focusing on people. On one hand, the technologies are appropriate, but the projects do not try to empower people during the process, missing its transforming potential. On the other hand, whilst considering the household as the intervention unit, the SLF does not analyse what goes on inside them. Therefore, one of the limitations of the approach is the impossibility to analyse intra-household inequalities caused by the asset or technological service. This is particularly relevant regarding gender inequalities within families. As we will explain in the article, electrification can cause extra work for women and reinforce their reproductive role.

In this respect, we consider the CA to have great potential to complement the approaches used by Practical Action, providing information about the implications of the use of technology in relation to the real options available to the beneficiaries of electrification projects.

**3. Contributions of the Capability Approach to Technological Projects**

*3.1 Development as the Process of Expansion of Real Freedom*

According to the CA, the main purpose of development is to expand people’s choices or, in other words, to create an enabling environment for people to enjoy long, healthy and creative lives. Therefore the information basis for measuring development is people’s capabilities to lead the lives they have reason to value (Sen 1999). Capabilities refer to the various combinations of functionings that a person can achieve. The functionings are the different states or activities that a person values being or doing. The fundamental difference between capabilities and functionings is that capabilities represent the full range of possible (achievable) functionings a person can choose from. In other words, a person can have certain capabilities (enjoy different freedoms) but choose to use them or not. These choices depend on the individual’s context, personality, life history and other factors (Robeyns 2005). Therefore, a main goal of the CA is to capture the importance of human diversity in judging advantage (Robeyns 2000): “The ability to deal with the conversion of commodity characteristics into functionings is a central tenet of Robeyns’ (2000) claim that Sen’s framework is sensitive to the attributes of individuals (intelligence, metabolism, etc.) and societies (gender roles, institutions, etc.)” (Iversen 2003, 104).

Sen does not define poverty as a lack of means (such as income or goods) that produces a result depending on people and contexts. Neither can we call poor those people who have not satisfied their preferences because these depend on the opportunities society offers and can also be manipulated (Teschl and Comim 2005). According to this approach, poverty primarily involves lack of freedom to fulfil the life plans one has reason to value. This is the most interesting part of this approach: not considering goods and services as well-being in their own right. According to Sen (1999, xii): “Development consists of the removal of various types of unfreedoms that leave people with little choice and Little opportunity of exercising their reasoned agency.”

Agency is a key concept of the approach and is directly related to the transforming role that development projects can play (Crocker 2008). Sen understands agency as “what a person is free to do and achieve in pursuit of whatever goals or values he or she regards as important” (1985, 206). So, people who enjoy high levels of agency are engaged in actions that are congruent with their values (Alkire, 2008). The concept of agency becomes especially relevant within the CA, as development is seen as the process of expansion of the real freedoms that people enjoy (Sen 1999). The more agency, the more ability there is for people to help themselves and to influence the world—both of which are key issues in development processes.

It is interesting to highlight the difference between well-being and agency in the CA. Well-being generally relates to personal satisfaction (e.g. how we feel when we help other people, or taste something pleasant). Agency refers to important personal goals regardless of their effect on the person’s well-being (Sen 1992, 1999). The difference between agency and well-being is therefore that the former concerns not only the goals and objectives that satisfy a person, but all of the goals and objectives one considers important.

*3.2 A framework to Analyse Gender Inequalities*

According to Nussbaum (2003), capabilities can help us construct a normative conception of social justice with critical potential for gender issues. But, why is the approach especially relevant for analysing gender issues? Sen gives the answer, stating that the focus of evaluations and judgements should be the real choices people have, and not only the resources available: “the question of gender inequality… can be understood much better by comparing those things that intrinsically matter (such as functionings and capabilities), rather than just the means [to achieve them] like…resources” (1992, 125). Gasper and Van Staveren (2003) provide an example: a woman can be free to qualify for a public post, but it is possible that her commitments and family care responsibilities prevent her from doing so. So it is not a real option to her. The challenge is for men to assume domestic chores to create a real possibility (positive freedom) for women. Women have the potential to become capable, so that is why their unequal failure in capability is, in Nussbaum (2000) words, a problem of justice.

Robeyns (2008, 2003) analyses the strengths and weaknesses of the CA in addressing gender issues. The first advantage, according to her, is the focus on individuals: capabilities and functionings are properties of individuals, so the units of normative judgement are individuals, not households or communities. This point is important for analysing gender inequalities since women’s well-being cannot be subsumed under wider entities. The second advantage is the inclusion of non-market dimensions of well-being, such as care labour or household work. Women are spending much more time outside the market economy than men, so the inclusion of these aspects in our normative analysis will reveal complexities in the distribution of well-being that an analysis of income alone cannot capture. The third advantage is that the approach acknowledges human diversity: the conversion of commodities into functionings can differ between people. Thus by conceptualizing gender inequality in the space of functionings and capabilities, there is more scope to account for human diversity, including gender.

However, the main weakness of the CA in analysing gender inequalities is its underspecified nature. As Robeyns (2008) stresses, additional theories are needed, and the selection of these theories can influence the outcome. From her point of view, different capability assessments can be made depending on the supplementary theory used. Thus, it is important to be aware that “the capability approach is vulnerable to androcentric interpretations and applications” (Robeyns 2003, 67). Instead, a feminist capability account would use a rich theory of gender to address gender inequalities in the conversion of the resources into capabilities, and gender inequalities in the capabilities sets, as well as how gender interacts with choice and personal responsibility (Robeyns 2008).

A complete analysis of gender inequality should also examine which inequalities in resources cause gender inequalities in capabilities and functionings. For example, Bina Agarwal (1994, 1455) has argued, in the context of South Asia, that “the ownership and control of property is the single most critical contributor to the gender gap in economic well-being, social status and empowerment.”

Moreover, Iversen (2003) points out that power inequality in the household affects the opportunities of the family members to achieve well-being and may even distort their preferences. The same autor mentions that in traditional societies, women may sacrifice their notion of well-being for the sake of the household.

This point, that of the adaptive preferences, is seen by many scholars of the CA as Sen’s main argument against utilitarianism (see, for example, Teschl and Comim 2005; Qizilbash 2006; Robeyns 2008; Clark 2012). Sen (1985, 1992) criticizes approaches that measure well-being in terms of utility. According to Sen, unfavourable circumstances can make allies out of the disadvantaged and deprived in so far as they “learn to take pleasure in small mercies and cut down their desires to modest—‘realistic’ proportions in order to avoid bitter disappointment” (1992, 55). For Clark (2012), adapting to what is feasible may be a good thing in as much as it reduces the amount of suffering and misery associated with objectively straitened circumstances. For Sen, the propensity to minimize difficulties and enjoy small breaks “is one way of being able to live peacefully with persistent deprivation” (2009, 283). In this regard, Qizilbash (1997) states that people may adjust to deprivation and hardship by developing “compensating abilities.” He illustrates it by giving an example: women might compensate for their perceived disadvantage in career prospects by working harder than men.

If people learn to adapt to their limited opportunities, for Sen it would be “ethically deeply mistaken to attach a correspondingly small value to the loss of well-being because of this survival strategy,” and he suggests that “the metric of happiness may, therefore, distort the extent of deprivation in a specific and biased way” (Sen 1987, 45). Thus, to evaluate people’s well-being in terms of capabilities and functionings guarantees a more objective picture of people’s life.

For Nussbaum (2000), preferences are not exogenous; unequal social and political circumstances give women unequal human capabilities: “Burdened, often, with the ‘double day’ of taxing employment and full responsibility for housework and child care, they lack opportunities for play and the cultivation of their imaginative and cognitive faculties” (2000, 220). Thus, she suggests that they may be under considerable social pressure to say they are satisfied despite the lack of these things. Clark’s (2002) experience from fieldwork in South Africa advocates that while the poor often report high levels of happiness (implying adaptation in terms of subjective well-being), they are still capable of imagining and demanding a substantially better form of life.

In short, the concepts of functionings and capabilities enable us to analyse the situation and position of women from the angle of their levels of objective well-being. So we argue that the CA offers a unique framework to identify gender inequalities and to provide solutions, capable of giving good guidance to a NGO or government for assessing the quality of life.

*3.3 Technological Aid Projects, Gender and the Capability Approach*

The introduction of technology in communities is not a neutral action and, as pointed out by MKenda- Mugittu (2003, 462), “the impact of introducing new technologies is generally negative on women’s work burdens and serves simply to reinforce their subordinate status and position relative to men.”

The Appropriate Technologies approach does not deal with this issue because it tends, in most cases, to offer technical solutions to specific problems without taking into account the internal dynamics of the community, the socio-economic context or complex issues such as gender relations (Fernandez-Baldor, Hueso, and Boni 2012).

The SLF has also overlooked the lack of opportunities for women. As we mentioned before, the SLF places the intervention focus on the family units. It does not analyse what happens inside the households, ignoring a space where potential inequalities may occur. As mentioned by Peter (2003), intra-household inequalities (particularly those between men and women) are a reflection of public inequalities, which makes household inequality a problem of social justice that should be addressed by development projects.

We argue that the main added value of the CA is to complement these approaches by providing information about the implications of the use and access of technology in relation to the real freedoms people can enjoy. And this is particularly relevant for analysing gender inequalities, at least for the three following aspects:

* Gender inequalities in technology access: the conversion of technological inputs, such as energy, differs between men and women. For example, illiterate women cannot read at night despite having light. Also, technology users differ in intersecting dimensions. These include personal differences such as enthusiasms for technological resources, and social differences—for instance, the extent to which race, ethnic, or gender differences are salient with regard to technology. So human diversity is stressed in the approach by the explicit focus on personal and socio-environmental conversión factors that make possible the conversion of technological resources into functionings, and on the social, institutional, and environmental context that affects the conversion factors and the capability set directly.
* Possibility to analyse intra-household inequalities caused by technology: by focusing on the capabilities and functionings of individuals, it is possible to analyse gender inequalities within families. If having light allows the family to obtain economic resources—for instance, selling juice from an electric blender—a normative analysis through the capabilities lens would interrogate the distribution of these resources and the consequences for each family member.
* The multidimensionality of well-being: the inclusion of dimensions such as spirituality, leisure, community participation, labour care, housework, and so forth, will reveal the consequences of the introduction of a given technology in terms of what people really value. This is particularly relevant in the case of women because they perform many non-market duties. Thus, the approach extends the basis of information of technological interventions and their consequences.

Since the CA seems to be an interesting framework for analysing technological aid projects, in the following paragraphs we briefly[[1]](#footnote-1) review the existing literature on technology and the CA.

Despite the potential of technology in terms of its contribution to well-being and the expansion of human capabilities, technology has not received sufficient attention by CA scholars. As Oosterlaken (2013, 7) suggests, “until recently the CA had […] hardly been applied as a theoretical and normative lens to look at technology,” and she states that “the only example of a technology found in the mainstream literature on the CA was a bicycle” but “used only to explain the approach.” However, this trend has been changing in recent years. Proof of this shift is that within the Human Development and Capability Association a thematic group on “technology and design” was created in 2009, and in 2011 the Human Development and Capability Association annual conference was devoted to technology, innovation and development. Moreover, in 2012 Oosterlaken and Van den Hoven edited a book bringing together several papers that explore the relationship between technology, design and the CA.

Most of the publications focused on technology and the CA have appeared since 2006. One approach to map these specialized publications would be by distinguishing works on the CA and the ICTs for Development (ICT4D), which are the majority, and those addressing the technology in a broader sense.

In the former group, amongst the most remarkable is the work done by Zheng (2009) on exploring the links between the CA and the ICT4D; that by Johnstone (2007) on the CA and computer ethics; and the work of Kleine (2013, 2011, 2010) that operationalized the CA in the form of the so-called “Choice framework,” which can be used by researchers to evaluate ICT4D projects. In fact, much work has used the CA for evaluating ICT4D projects, such as websites (Wresch 2009), podcasting devices (Oosterlaken, Grimshaw, and Janssen 2012) or telecentres (for example, Vaughan 2011).

In the latter group, most notable is the work by Oosterlaken (2012, 2011, 2009) regarding the links between technology and design issues with the CA; Johnstone’s (2012) discussion about the effects of technology on human capabilities; Coeckelbergh’s (2011) use of the philosophy of technology to analyse the role of technologies on human enhancement; or the “Technologies for Freedom” presented by Fernández-Baldor, Hueso, and Boni (2012; Fernández-Baldor, Boni, and Hueso 2012), applying the CA to technological aid projects in order to explicitly expand people’s freedom and agency.

Most of the work carried out so far using the CA to assess technological development projects has mainly focused on evaluating ICT4D projects, but less work has been done on evaluating traditional technologies (water supply, sanitation, electrification, etc.) implemented in developing contexts through the lens of the CA. An exception is the work by Fernández-Baldor, Hueso, and Boni (2012), comparing rural small hydro power projects in Bolivia and Guatemala from the perspective of the CA. They argued that electrification projects, when properly set up and implemented, can help people collectively become agents of change rather than being mere recipients of transferred technology. Thus, electrification projects can expand people’s capabilities but also their agency (individually and collectively). The authors concluded that more research was needed to evaluate other rural electrification technologies (such as photovoltaic or wind) and deepen the analysis of the gender impact of projects.

The study presented here emerges from this conclusion and tries to help fill the gap on assessments of aid projects with traditional technologies (still very common in development contexts). The added value of this work lies in comparing different electrification technologies and their impact on people’s wellbeing, focusing on gender inequalities. To this end, this research presents an ad hoc methodology for analysing electrification projects through the CA, with special attention to gender.

**4. Case study: Practical Action Electrification Projects in Cajamarca**

To illustrate the potential of the CA to examine technological projects, we present the results of a case study that analyses four different rural electrification projects implemented by Practical Action in Cajamarca, Peru.

*4.1 Practical Action Projects Management System*

Practical Action is a NGO of international technical cooperation that has been operating in Latin America since 1985. The office located in the Peruvian region of Cajamarca is in charge of the energy projects, which aim to provide rural communities with access to sustainable renewable energy-based off-grid services.

We now explain the intervention protocol of the NGO in order to provide a better understanding of the project process: firstly, Practical Action gives priority to interventions in communities that have requested the implementation of a project. In other cases, Practical Action selected a community and proposed a project to the people. Once the project has been accepted, a socio-economic study is undertaken, using questionnaires and interviews with community leaders. The technical team then prepares the technical design of the systems and the project report.

For a number of years Practical Action has been developing a management scheme for the implementation of the electrification projects, based on the following stakeholders: the microenterprise (run by community members, in charge of the operation, maintenance and administration of the system); the users (the families that consume electricity); and the supervisory board (consisting of community people, in charge of supervising the management of the microenterprise and of dealing with user complaints and suggestions).

Of particular relevance in this management scheme are the roles of the operator and the administrator of the microenterprise. They are in charge of the operation and maintenance as well as the collection of a monthly fee, which is saved in a joint bank account in order to replace old equipment. Between four and eight people within the community are trained to handle the equipment, and two of them are chosen in the community assembly to take these responsibilities.

Despite having over 30 years of experience in technological projects, the NGO itself acknowledges a problem with the projects’ sustainability. In July 2010, in two different workshops in Lima and Cajamarca involving Practical Action decision-makers, it became obvious that the projects sometimes failed due to factors not linked to the implemented electrification technology; for instance, community power struggles, poor participation of local people, established social rules or relationships with local governments. In addition, most of the NGO technicians agreed on the influence of external factors such as the presence of the mining enterprise Yanacocha (close to the intervention place and which implements projects in the communities) on the sustainability of the intervention. The hand-out dynamic surrounding the Yanacocha projects accustoms the communities to receive projects without any contribution on their behalf, reducing their participation.

The objective of the study initiated in a visit in August 2010 was to find a reason for the sparse sustainability detected. In this visit, the broad research outlines were defined and later on, in 2011, the fieldwork took place. During 2012 feedback was given through two workshops with the organization technicians and management staff.

During the research period, four projects were analysed with the general characteristics presented in Table 1.



Source: The authors.

Wind and photovoltaic solar systems are both defined by resource variability and thus need batteries to store the electricity generated. This fact restricts the use of high-power appliances (such as irons or electric cookers) or other appliances that need continuous supply (such as refrigerators). However, hydropower systems can generate electricity 24 hours a day, allowing a wider range of appliances and also a productive use of the energy.

On the other hand, installing wind and solar systems is easier than installing hydro power systems. The installation of the two first systems can take just a day with the support of a few people, while micro hydro power plants require building infrastructure such as channels or engine rooms. This requires the labour of the whole community for a number of months.

*4.2 Methodology for Project Analysis Using the Capability Approach*

The works of Alkire (2002), Biggeri et al. (2006), Frediani (2008) and Muñíz (2009) were the prime inspiration for the research methodology design. A few tools were introduced to obtain data related to the context and to the conversion factors affecting the capabilities of the people. It also focused on finding out the relationship between the electrification projects and expansion of capabilities, particularly with reference to gender issues.

Table 2 displays the methodology steps as well as the data required in each of the research phases. The comprehension of the context (and the rest of conversion factors) was achieved through semistructured interviews with key informants: Practical Action decision-makers and technicians, staff from other Peruvian and foreign development NGOs, and also with Peruvian University researchers and other key stakeholders in Lima and Cajamarca.



Source: The authors.

The main feature of the fieldwork was the fact that it was co-designed with Practical Action, from the research objectives to the workshop structure, the community selection, the field visits and the discussion of research results. The contributions of Practical Action staff, particularly the team of sociologists, were key to refining the fieldwork methodology in the communities. Another important aspect to highlight was the participatory character of the methodology. Table 3 displays the main characteristics of the fieldwork in the communities with techniques used and their objectives.

The methodology has an important gender component. Firstly, the participatory workshops took place separately in each community, one for women and another for men. This allowed women to express themselves freely without their husbands present. Secondly, the Uses of Time technique was applied during the individual interviews to monitor the differences between women’s and men’s chores. In addition, the work of the focus groups provided information about women’s access to posts of responsibility in the community, as well as about their access to, and participation in, the electrification project.

The participatory workshops in the communities were the key tool for the collection of information regarding the things people value and their relationship to the project. The main question discussed by the participants during the first meeting was: what are the things or opportunities you would like your children to enjoy in the future? The objective of asking this question was to determine the things people value in their lives. The second part of the workshop focused on the positive and negative effects of the electrification project. The participants were asked to complete the following sentence: “I like the project because now…” and “I don’t like the project because now…” Then links were established between the things people valued and the effects of the project. The workshop ended with a group reflection on how the project impacts on the things people valued.

It is important to highlight that more men participated in the workshops than women. This is caused by the fact that generally the representative from Practical Action that coordinates the community visits and the contact person in the community are both men. Consequently, women’s preferences and possibilities of participation are not taken into account. In some cases the workshops took place at the time of the day when the women were preparing their husbands’ lunch or milking the cows. This problema was addressed by adapting in situ the timings of the activities to the women’s availability, and increasing the number and depth of individual interviews to women.



Source: The authors.

**5. Analysis and Discussion of Results**

*5.1 Extending the Basis of Information for the Interventions Analysis*

One of the key elements during the participatory workshops in the four communities was to determine the things that people value and their relationship with the project. According to Practical Action (ITDG 2007), the projects provide different benefits to the communities: reduced air pollution as they substitute candles or kerosene for electricity; improved access to communication through television and radio; the possibility of night study under appropriate light; the use of computers and audiovisual equipment in schools; and improvement of local medical centre equipment. On the other hand, there is some cost-saving for people because the cost of electricity is lower than that of candles, kerosene, batteries, and so forth. Finally, the productive use of energy in local business such as restaurants, hostels and mills can improve production and sales, and can thus provide an economic benefit for the community.

The research confirms those benefits but also, using the CA, detects an expansion of the capabilities in other areas not considered by Practical Action. Some participants from the Campo Alegre community highlighted the fact that the project enabled them to establish connections with other people, to read the bible at night-time or to discover new professions through television. In the Alto Peru community, the participants valued the availability of light for their own security at night against robbery as well as the opportunity to celebrate night assemblies, which increased community participation. In the Chorro Blanco community, the participants emphasized that the light made their community more attractive, reducing the emigration of the young as well as enabling people from other communities to settle in the area. Also, in El Regalado the participants felt that electric lighting had promoted an increased sense of collective dignity: “We are not envious of city life” was a statement in one of the workshops.

However, the fact that not all families enjoy electric lighting can provoke some discord in the community. While the beneficiary families acknowledge the strength acquired with the project, those without the service were left behind. Technological projects can generate inequalities and this has to be taken into consideration when planning this type of intervention.

We are interested in taking an in-depth look into the differences amongst the technologies implemented: wind, solar, hydro or the combination of those. It is important to highlight the fact that those projects which supplied more energy (as is the case of two communities supplied by hydro power plants) better satisfied the community members and expanded their set of capabilities to a greater extent. The more energy available, the more energy uses such as productive activities, Street or leisure lighting. Also, the reliability and robustness of the hydro power systems lead to a greater satisfaction among the people, as compared with the wind or photovoltaic systems with lower levels of energy and stability.

The technology implementation process also has consequences on the strength of the community. The two projects with wind technology did not generate collective processes in the same way as the hydro power projects did. As the technology is simpler, Practical Action does not create comunal spaces for community participation; instead, the NGO technicians perform their work in each household. Conversely, in the two communities with hydro power systems, the implementation processes took longer and the people participated actively in the construction of the infrastructure; men did building work (i.e. channels) and women carried materials and prepared food. The fact that it is a type of technology that requires more labour than the others has an impact on community participation and therefore in building a sense of community: “We all made it together,” said a woman in El Regalado. However, as we found in previous research comparing hydro power projects in Guatemala and Bolivia (Fernández-Baldor, Hueso, and Boni 2012), using technology that requires a long process of implementation does not guarantee empowerment and agency amongst community members. Other issues such as motivation, community participation, knowledge creation and capacity-building should be considered when planning projects. In our view, those aspects should be explicitly addressed by Practical Action, taking advantage of their transforming potential.

*5.2 Gender Inequalities in Technological Projects*

The presence of light in homes increases the number of activities that can be performed throughout the day, but the type of activities differs greatly between the genders. For instance, it is commonplace for men to watch television or play an instrument at night time while women knit or sew until late. Therefore men extend their leisure time while women extend their working time. However, women affirm their happiness in being able to complete these chores and thus improve their families’ welfare. It seems that we are facing a woman’s adaptive preference because, as Iversen (2003) pointed out, they sacrifice her own personal well-being for the sake of the household. Moreover, the research analyses the well-being of women in terms of capabilities and functionings, revealing that men are freer than women in pursuing things they value (e.g. studying at night or participating in community assemblies). Thus, according to Nussbaum (2000, 220):“they [women] lack opportunities for play and the cultivation of their imaginative and cognitive faculties.”

Another issue highly valued in the workshops was religion; in particular, reading the bible and the possibility of watching religious movies. Men can read the bible and watch religious movies at night-time, enjoying their spiritual development. However, women are not able to take advantage of this in the same way. The high level of illiteracy among women prevents them from reading the bible. And, as stated before, the increase in their domestic night chores does not leave them time for the development of their spiritual life or other such pastimes.

The research also shows inequalities in the opportunities to participate in the community. Women mention their lack of time or possibilities to attend meetings or assemblies at the times they are proposed: “We cannot take children to the meetings” or “meetings are very early and we have to milk the cows” were answers given during the interviews by one woman in Alto Perú and another in Campo Alegre. In this respect, the research identifies the lack of mechanisms applied by Practical Action team to improve women’s access to participation spaces.

On the other hand, when women attend meetings they tend to adopt a listening role instead of an active one. This is confirmed by some testimonies such as that by the APAFA President (a parents’ association) in Chorro Blanco who explains why she does not speak during the meetings: “Sometimes I feel a bit shy, I cannot find the words and that’s scary.” Another woman in Alto Perú explains: “I would have liked to give my opinion but it was my husband who gave it.” However, there are illiterate men who do feel free to participate actively in the meetings.

As we mentioned in Section 4.1, the project gives two types of training: one directed towards the final users, and another towards the operators and administrators. In the first type, it has been observed that the acquisition of technical knowledge about the electrical systems improves the population’s self-esteem. But who attends the training meetings? Again it is the male population that can take advantage of this project resource: “We have enough knowledge to look after the equipment. If it does not work, it is because it has not been looked after properly” or “if we pay less there won’t be money to buy batteries” are men’s comments expressed during the leaders workshops in Alto Perú. These comments give evidence of the appropriation of knowledge by the men. Alternatively, in the cases when women claim to have learnt something about the operation or maintenance of the systems it is because their husbands taught them: “Only my husband took part in the training” or “I did not learn, it was my husband,” explained two women from Alto Perú and Chorro Blanco.

The second type of training for operators and administrators is restricted to men and is the type of training that actually increases capabilities. “I feel more valued,” “I feel more appreciated by the community” or “I like to be an operator because I learn more. Knowing something, I can go and work as an electrician anywhere” are some of the answers given by the interviewees who were receiving training to be operators or administrators in the community. However, women do not have access to these posts of responsibility for various reasons. Firstly, these are traditionally male posts. In the rural context of Cajamarca it is assumed that any technical post belongs to men. As we mentioned in the previous section (Section 5.1), men are in charge of building the infrastructure for the hydro power plant while women carry materials and prepare the food. This, together with a lower level of education for women and the timetable incompatibility of the training sessions for operators and administrators, hinders the expansion of the capability set of women.

Finally, the workshop results and the interviews reveal that most projects did not generate women agency. In some cases, there are indications of the potential of training to strengthen agency. This is the case for the Mayor in Alto Perú, who explains: “We need training to become stronger. If we are not trained we don’t know how to claim.” Obviously if women cannot attend the training sessions, agency improvement will not take place for them.

**6. Contributions of the Capability Approach to Practical Action Project Planning**

Despite the resistance to face gender issues in rural development contexts, one of the most interesting features of the CA is that it has enabled us to discuss sensitive issues such as gender inequalities produced by electrification projects with Practical Action. If these issues had been discussed from other more radical approaches, perhaps we would have found opposition from Practical Action. This is because the approach allowed us to address well-being in a broader sense, extending the basis of information from which to make assessments of projects. In this regard, the research confirmed an expansión of the capabilities in positive areas unexpected by Practical Action, while it also found some negative aspects.

The following are some of the recommendations proposed to Practical Action, which were discussed and produced together with the people responsible for the energy programme in Cajamarca, their technicians and also staff from other NGOs linked to the organization. Our intention was to offer realistic recommendations, relevant to the context in Cajamarca and feasible for the organization to put into practice, sacrificing more radical options, related for instance to gender, but extremely difficult to implement.

The first suggestion to Practical Action is to include a different type of information when planning projects. Presently, and following World Bank recommendations, they gather socio-economic quantitative information. This has proved to be not sufficient, and it would be appropriate to gather information about values, customs, gender roles, and leadership in the community, amongst others. This means that Practical Action technicians need to have the skills required for this.

It is also necessary to increase community participation in all stages of the project cycle. Previously, diagnosis and technological choice have been carried out by Practical Action, selecting individual or collective technological alternatives based on their own criteria. However, we believe that it should be posible to organize training activities to provide community members with information about the identification and management of natural resources through technology. Regarding project implementation, we have identified low levels of attendance atmeetings and community assemblies due to timetable incompatibilities with the work duties of most communitymembers, as so far themeetings were planned by Practical Action staff. To solve this problem, we would advise that the community itself defines the timings of the meetings, and that Practical Action staff adapt to them instead of the other way round.

We also recommend including specific activities to deal with gender inequalities. To this end an allocated budget is necessary to ensure the availability of gender resources during the project. It would also be good to have specific gender indicators to assess the projects’ success in this respect. In particular, it would be very useful to instigate the following:

* Appoint a female coordinator to plan the meetings with Practical Action and in doing so take into proper consideration women’s availability. This position of responsibility would also increase their agency.
* Include women in the posts of responsibility. One option could be to establish a quota of women’s participation in the microenterprise and supervisory board, which will make them visible and ensure their representation, as well as improve gender equity. Another option, which could transform power structures, would be to impose that either the operator or the administrator was a woman. This would help the community realize that women can perform both in technical and administration posts, thus improving women’s agency. The same method could be applied to the construction of infrastructure or the installation of energy systems where women could also become visible and perform the same tasks as men.
* Organize separate meetings or workshops for men and women to ensure women’s participation, because it has been proven that power imbalance restricts women from publicly expressing their personal, political or ideological opinions.
* Offer specific training for women and their organizations. This would reinforce their self-esteem and also their ability to discuss issues in public, giving them the confidence to actively participate in the meetings.

Finally, expanding the agency should be a specific target of Practical Action when planning projects. Given that different electrification technologies show indications of diverse effects in terms of empowerment and agency, this should be a factor to consider when choosing one technology over others. Also, the fact that local governments contribute to the budgets of the projects is an important opportunity to increase agency. This contribution should be used to open a space for discussion between the community and the local governments and to reinforce the collective agency of the communities.

**7. Conclusions—Technology: Necessary but Not Sufficient for Development**

Most of the work carried out so far using the CA to assess technological projects has mainly focused on evaluating ICT4D projects. This research is intended to help fill this gap by providing a case study evaluating traditional technologies; in this case, four energy-based projects. The added value of this work lies in the comparison of different electrification technologies and their impact on people’s well-being, focusing on gender inequalities.

The research has revealed the limitations of interventions focused solely on supplying technology, electrification in this particular case, without taking into account certain elements that can make the use of technology contribute unequally to the expansion of people’s capabilities. In the projects analysed in this research, the most relevant factor explaining these inequalities is gender, which needs to be urgently addressed by Practical Action when planning their projects. Neither agency is an issue explicitly taken into account by Practical Action. Thus, most of the recommendations of the previous section are aimed at helping Practical Action promote a more even expansion of people’s capabilities and agency.

This study also confirms the potential of the CA to complement other approaches—such as Appropriate Technologies or the Sustainable Livelihoods Approach—by providing information about the implications of the use of and access to technology in relation to the real freedoms people can enjoy. As this study shows, this is particularly relevant when analysing gender inequalities.

This research also has certain limitations. It has not analysed, for instance, the development of children’s capabilities due to limitations of time and resource. Likewise, the case studies could be extended to other communities and other types of technology. Research currently in progress is taking into consideration these limitations, trying to look in depth into the aspects missing in this article. It is therefore a living collaborative process between an NGO and the university, which will hopefully contribute to the improvement of technological interventions and offer some clues in how to use all the potential of the CA for development.

**Acknowledgements**

We would like to thank the people from the Peruvian communities where the case study was implemented. Many thanks also to Practical Action-Peru for their collaboration, and to the Centro de Cooperación al Desarrollo of our University who granted this research through Adsideo 2010, and special thanks to José Sastre for his involvement during the fieldwork.

**References**

Agarwal, B. 1994. “Gender and Command Over Property: A Critical Gap in Economic Analysis and Policy in South Asia.” World Development 22 (10): 1455–1478.

Alkire, S. 2002. Valuing Freedoms: Sen’s Capability Approach and Poverty Reduction. Oxford: Queen Elizabeth House Series in Development Studies, Oxford University Press.

Alkire, S. 2008. “Concepts and Measures of Agency.” In Arguments for a Better World: Essays in Honor of Amartya Sen. Volume I: Ethics, Welfare and Measurement, edited by K. Basu, and K. Ravi, 455–474. Oxford: Oxford University Press.

Biggeri, M., R. Libanora, S. Mariani, and L. Menchini. 2006. “Children Conceptualizing their Capabilities: Results of a Survey Conducted During the First Children’s World Congress on Child Labour.” Journal of Human Development and Capabilities 7 (1): 59–83.

Chambers, R., and A. Conway. 1991. “Sustainable Rural Livelihoods, Practical Concepts for the XXI Century.” IDS Discussion Paper No. 296, Brighton, UK.

Clark, D. 2002. Visions of Development: A Study of Human Values. Cheltenham: Edward Elgar.

Clark, D. 2012. “Adaptation and Development – Issues, Evidence and Policy Relevance.” In Adaptation, Poverty and Development. The Dynamics of Subjective Well-Being, edited by D. Clark, 1–34. Basingstoke: Palgrave Macmillan.

Coeckelbergh, M. 2011. “Human Development or Human Enhancement? A Methodological Reflection on Capabilities and the Evaluation of Information Technologies.” Ethics and Information Technology 13 (2): 81–92.

Crocker, D. 2008. Ethics of Global Development: Agency, Capability, and Deliberative Democracy. Cambridge: Cambridge University Press.

Fernández-Baldor, Á., A. Boni, and A. Hueso. 2012. “Technologies for Freedom: una visión de la tecnología para el desarrollo humano.” Estudios de Economía Aplicada 30 (3): 971–996.

Fernández-Baldor, Á., A. Hueso, and A. Boni. 2012. “From Individuality to Collectivity: The Challenges for Technology-Oriented Development Projects.” In The Capability Approach, Technology and Design, edited by I. Oosterlaken, and J. Van der Hoven, 135–152. Dordrecht: Springer.

Frediani, A. 2008. Housing freedom, Amartya Sen and urban development policies. Squatter settlement upgrading in Salvador da Bahia, Brazil, Thesis dissertation, Brookes University, Oxford.

Gasper, D., and I. van Staveren. 2003. “Development as Freedom – and as What Else?” Feminist Economist 9 (2–3): 137–161.

Griffin, K. 1991. “Foreign Aid and the Cold War.” Development and change 22: 645–685.

Herrera, A. 1983. Transferencia de tecnología y tecnologías apropiadas: Contribución a una visión prospectiva a largo plazo, Thesis dissertation, Unicamp, Campinas (Brazil).

ITDG. 2007. Organización de servicios eléctricos en poblaciones rurales aisladas, Serie de Manuales de Soluciones Prácticas, n° 32, ITDG—Soluciones Prácticas, Lima.

Iversen, V. 2003. “Intra-household Inequality: A Challenge for the Capability Approach?” Feminist Economist 9 (2–3): 93–115.

Johnstone, J. 2007. “Technology as Empowerment: A Capability Approach to Computer Ethics.” Ethics and Information Technology 9 (1): 73–87.

Johnstone, J. 2012. “Capabilities and Technology.” In The Good Life in a Technological Age, edited by P. Brey, A. Briggle, E. Spence, 77–91. New York: Routledge.

Kleine, D. 2010. “ICT4WHAT?-using the Choice Framework to Operationalise the Capability Approach to Development.” Journal of International Development 22 (5): 674–692.

Kleine, D. 2011. “The Capability Approach and the ‘Medium of Choice’: Steps Towards Conceptualising Information and Communication Technologies for Development.” Ethics and Information Technology 13 (2): 119–130.

Kleine, D. 2013. Technologies of Choice?: ICTs, Development and the Capabilities Approach. Cambridge: MIT Press.

Mkenda-Mugittu, Vera F. 2003. “Measuring the Invisibles: Gender Mainstreaming and Monitoring Experience from a Dairy Development Project in Tanzania.” Development in Practice 13 (5): 459–473.

Motta, R. 1996. Epistemología de la Tecnología: una aproximación a la definición de tecnología y a las nociones de tecnologías adecuadas y/o apropiadas. Buenos Aires: Vicerrectorado de Investigación, Universidad del Salvador.

Muñíz, M. 2009. Human development and autonomy in project aid: experiences from four bilateral projects in Nicaragua and El Salvador, MGSoG Dissertation Series (4), Boekenplan, Maastricht.

Nussbaum, M. C. 2000. “Women’s Capabilities and Social Justice.” Journal of Human Development 1 (2): 219–247.

Nussbaum, M. C. 2003. “Capabilities as Fundamental Entitlements: Sen and Social Justice.” Feminist Economist 9 (2–3): 33–59.

Oosterlaken, I. 2009. “Design for Development; A Capability Approach.” Design Issues 25 (4): 91–102.

Oosterlaken, I. 2011. “Inserting Technology in the Relational Ontology of Sen’s Capability Approach.” Journal of Human Development and Capabilities 12 (3): 425–432.

Oosterlaken, I. 2012. “Inappropriate Artefacts, Unjust Design? Human Diversity as a Key Concern in the Capability Approach and Inclusive Design.” In The Capability Approach, Technology and Design, edited by I. Oosterlaken, and J. Van der Hoven, 223–244. Dordrecht: Springer.

Oosterlaken, I. 2013. Taking a Capability Approach to Technology and Its Design; A Philosophical Exploration. Thesis dissertation, 3TU.Centre for Ethics and Technology, Delft.

Oosterlaken, I., D. Grimshaw, and P. Janssen. 2012. “Marrying the Capability Approach with Appropriate Technology and STS— The Case of Podcasting Devices in Zimbabwe.” In The Capability Approach, Technology and Design, edited by I. Oosterlaken and J. Van der Hoven, 113–133. Dordrecht: Springer.

Peter, F. 2003. “Gender and the Foundations of Social Choice: The Role of Situated Agency.” Feminist Economist 9 (2–3): 13–32.

Qizilbash, M. 1997. “A Weakness of the Capability Approach with Respect to Gender Justice.” Journal of International Development 9 (2): 251–262.

Qizilbash, M. 2006. “Well-being, Adaptation and Human Limitations.” Royal Institute of Philosophy Supplements 81: 83–110.

Robb, C. 2004. “Changing Power Relations in the History of Aid.” In Inclusive Aid. Changing Power and Relationship in International Development, edited by L. Groves and R. Hinton, 21–41. London: Earthscan.

Robeyns, I. 2000. “Un Unworkable Idea or a Promising Alternative? Sen’s Capability Approach Re-Examined.” Discussion Paper No. 00.30. Katholieke Universiteit, Leuven.

Robeyns, I. 2003. “Sen’s Capability Approach and Gender Inequality: Selecting Relevant Capabilities.” Feminist Economist 9 (2–3): 61–92.

Robeyns, I. 2005. “The Capability Approach: A Theoretical Survey.” Journal of Human Development 6: 93–117.

Robeyns, I. 2008. “Sen’s Capability Approach and Feminist Concerns.” In The Capability Approach. Concepts, Measures and Applications, edited by F. Comim, M. Qizilbash, and S. Alkire, 82–104. Cambridge: Cambridge University Press.

Schumacher, E. F. 1973. Small is Beautiful. Economics as if People Mattered. New York: Harper and Row.

Sen, A. 1985. “Well-being, Agency and Freedom: The Dewey Lectures 1984.” The Journal of Philosophy 82: 169–221.

Sen, A. 1987. On Ethics and Economics. Oxford: Blackwell.

Sen, A. 1992. Inequality Reexamined. New York; Oxford: Russell Sage Foundation; Clarendon Press.

Sen, A. 1999. Development as Freedom. New York: Oxford University Press.

Sen, A. 2009. The Idea of Justice. London: Allen Lane.

Teschl, M., and F. Comim. 2005. “Adaptive Preferences and Capabilities: Some Preliminary Conceptual Explorations.” Review of Social Economy 63 (2): 229–247.

Unceta, K. 1996. “El hambre como fracaso del desarrollo.” In Incendio frío. Hambre, Alimentación, Desarrollo, edited by B. Sutcliffe (Coord.), 57–74. Barcelona: Icaria.

Vaughan, D. 2011. “The Importance of Capabilities in the Sustainability of Information and Communications Technology Programs: The Case of Remote Indigenous Australian Communities.” Ethics and Information Technology 13 (2): 131–150.

Wresch, W. 2009. “Progress on the Global Digital Divide: An Ethical Perspective Based on Amartya Sen’s Capabilities Model.” Ethics and Information Technology 11 (4): 255–263.

Zheng, Y. 2009. “Different Spaces for e-development: What can we Learn from the Capability Approach.” Information Technology for Development 15 (2): 66–82.

1. For a more detailed literature review, see Oosterlaken (2013). [↑](#footnote-ref-1)