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# *Are technological projects reducing social inequalities and improving people's wellbeing? A Capability Approach analysis of renewable energy based electrification projects in Cajamarca, Peru.*

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## **Abstract**

This paper analyses four renewable energy based electrification projects in the rural area of Cajamarca in Peru implemented by the NGO Practical Action. Using the Capability Approach, the research examines the projects effects on the things people value. It confirms that projects provide different benefits to the communities (reducing air pollution caused by candles and kerosene, improving the 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 NGO related to religion, leisure or community participation. However, the expansion of capabilities is different among men and women. The study reveals the limitations of interventions directed to supply technology, electrification in this particular case, that don't take into account certain elements which 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 given in order to be taken into consideration when planning the interventions.

**Keywords:** off-grid electrification, project planning, capabilities, gender, Peru

## **Introduction**

Technological cooperation projects which provide goods or basic services to people's wellbeing are generally welcome by rural settlements. Who does not want to have drinking water supply or electricity in their community? It's for this reason that donors, NGOs and the rest of the stakeholders in the International Development Cooperation System dedicate a considerable amount of their aid to basic infrastructure technological projects.

However, transferring the benefits of technology to society is not an easy job, especially in complex environments such as the least developed areas of the world, where there are many different elements to take into account when planning projects. Development aid interventions have generally been implementing technology strictly as a necessary input for development. In practice the projects focused on supplying a technological good or service. This is precisely their main limitation: focusing only on technology instead of focusing on people, missing thus the project's potential for social transformation.

Instead, can we imagine technological development projects not only as a means to provide a good or a service but also as a tool for helping people to shape their own lives and 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. 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 organised as follows: firstly we analyse the paradigms which have been framing the technological interventions in the development sector and particularly we focus on those currently used by Practical Action in their projects such as appropriate technologies and sustainable livelihood framework. Secondly we analyse the contributions of the Capability Approach to technological interventions building on these approaches. Then, we present an *ad hoc* methodology for analysing the rural electrification projects from the perspective of the Capability Approach. Lastly we will discuss the research results and suggest recommendations for the planning of development projects.

### **The need for a people-centred technology**

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

This vision of development as economic growth permeated and changed the methods for International Cooperation: technology was progress and progress should be transferred to underdeveloped countries to get out of poverty. The objective was to take industrial development to the 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 70's the Appropriate Technology Movement (Herrera, 1983) emerged as a result of the concern for environmental sustainability and the impact of the modernisation and technology transfer model on the South. In fact, the origin of the Appropriate Technology concept goes back to Gandhi's in colonial India (Motta, 1996), who advocated for a decentralized productive system in opposition to the modernisation 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 proposes the economic and social development of rural areas to avoid massive migration movements to the cities, creating a 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 due to its complex nature (Schumacher, 1973).

The implementation of Appropriate Technologies meant first to address technological development bringing back old or unused technologies, improving them if necessary. It also 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 participate in the different phases of the project, but their role is confined to unskilled work while the engineer is the person in charge of adapting the technology to the community.

The NGO Practical Action was created by E.F. Schumacher in the 60's and ever

since they have been working with Appropriate Technologies. However, Practical Action takes into consideration the debates about development and its complexity and for this reason they complement the use of Appropriate Technologies with other approaches and methods such as the Sustainable Livelihoods Framework (SLF).

Chambers and Conway (1991, p. 6) defined livelihood as '[...] the capabilities, assets (stores, resources, claims and access) and activities required for a means of living'. The SLF approach suggests that the families 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 in 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.) with the intention of supporting the livelihoods of rural families. However, as we 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 good or the technological service instead of focusing on the people. On the one hand the technologies are actually appropriate but the projects do not try to empower people during the process, missing their transforming potential. On the other hand, the SLF considers household as the intervention unit but does not analyse what goes on inside them. Therefore one of the limitations of the approach is the impossibility to analyse intra family inequalities caused by the good or technological service. This is particularly relevant in the case of gender inequalities within the families. As we will explain throughout the article, electrification can cause extra work for women and reinforce their reproductive role.

In this respect, we consider the Capability Approach to have a 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 open to the beneficiaries of the electrification projects.

## **Contributions of the Capability Approach to the technological projects**

### *Development as the process of expansion of real freedom*

According to the Capability Approach, development interventions are successful when a wider range of options to lead their lives is available to people. Therefore the information basis for measuring development is the people's capabilities to lead the lives they have reason to value.

A capability shows what a person can do or be, regardless of the choice to fulfil it (capability as opportunity), as the set of freedoms that individuals enjoy to lead the life they choose to live. The functionings are the different states or activities that a person values being or doing. The fundamental difference between capabilities and functionings is that the 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 Capability Approach 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, p.104).

Sen does not define poverty as a lack of means (such as income or goods) that produces a result depending on the people and the contexts. Neither can we call poor those people who have not satisfied their preferences as these depend on the opportunities society offers and can also be manipulated (Tesch and Comim, 2005). According to this approach, poverty primarily involves lack of freedom to fulfil the life plans one has reason to value. And this is precisely the most interesting side to this approach: not considering goods and services as wellbeing for themselves. According to Sen (1999, p. xii) 'Development consist of the removal of various types of unfreedoms that leave people with little choice and little opportunity of exercising their reasoned agency'.

Agency is indeed 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' (Sen, 1985, p. 206). So that 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 under the Capability Approach as development is seen as the process of expansion of the real freedoms that people enjoy (Sen, 1999). The more agency, the more ability for people to help themselves and to influence the world, both of which are key issues for development processes.

It is interesting to highlight the difference between wellbeing and agency in the Capability Approach. Wellbeing generally relates to personal satisfaction (for example how we feel when we help other people or taste something nice). Agency refers to the important personal goals regardless of their effect on the person's wellbeing (Sen, 1992; 1999). Therefore the difference between agency and wellbeing is that the first one concerns not only the goals and objectives that satisfy a person, but all the goals and objectives one considers important.

#### *A framework to analyse gender inequalities*

The introduction of technology in communities is not a neutral action and, as pointed out by MKenda-Mugittu (2003, p. 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 as it tends in most cases to offer technical solutions to specific problems without taking into account the internal dynamics of the community, the socio-economical context or complex issues such as gender (Fernandez-Baldor *et al.*, 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 family inequalities (particularly those between men and women) are a reflection of public inequalities, which makes it a problem of social justice that should be addressed by development projects. The Capability Approach reminds us that people should be at the centre of development projects. Therefore it is crucial to understand the distribution of resources within the household and to analyse the impact of the interventions at the individual level, so that inequalities can be identified. As Nussbaum states:

‘Resources have no value in themselves, apart from their role in promoting human functioning. It therefore directs the planner to inquire into the varying needs individuals have for resources, if they are to become capable of an equal level of functioning’ (Nussbaum, 2000a, p. 5).

Iversen (2003) points out, moreover, that power inequalities in the household affect the opportunities of the family members to achieve wellbeing and may even distort their preferences. The same author mentions that in traditional societies, women may sacrifice their notion of wellbeing for the sake of the household. Sen (1990) also reminds us of the need to research the feminine elements of agency that allow women to mediate in intra family relationships.

In addition, the Capability Approach goes beyond negative freedom (what interferes in a person being able to be or do something) and focuses on positive freedom (what a person can be or do). Gasper and Van Staveren (2003) clarify this difference giving 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. The authors say that working outside the home reduces women’s deprivation as it provides economic independence from the husband or more possibilities to freely buy in the market. However, the challenge is for men to assume domestic chores to create a real possibility (positive freedom) for women.

In short, the Capability Approach offers a unique framework to identify gender inequalities and to provide solutions (Nussbaum, 2000b). The concepts of functionings and capabilities enable us to analyse the situation and position of women from the angle of their levels of objective wellbeing. According to Zabala (2001), making wellbeing objective involves the possibility for interpretation of women perceptions about their contributions, needs, and legitimacy in terms of existing social rules and values determined in each society by gender relations.

### **Case study: Practical Action electrification projects in Cajamarca**

In order to illustrate the potential of the Capability Approach to examine technological projects we present the results of a case study which analyses four different rural electrification projects implemented by Practical Action in Peru.

#### *Practical Action projects management system*

Practical Action is a development NGO of international technical cooperation 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 renewable energy based off-grid sustainable services.

We now explain the intervention protocol of the NGO, in order to provide a better understanding of the projects process: Firstly, Practical Action gives priority to interventions in communities that have demanded the implementation of a project. In other cases Practical Action selected a community and proposed them a project. Once the project has been accepted, a socio-economical study is undertaken, using questionnaires and interviews to community leaders. Then the technical team 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 which consume electricity); and the supervisory board (consisting of community people, in charge of supervising the management of the microenterprise and of dealing with the users' 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 4 and 8 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 thirty 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 with Practical Action decision makers, it became obvious that sometimes the projects 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 interventions' sustainability. The hand-out dynamics around the projects of Yanacocha 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 an answer to the little 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 a couple of workshops with the organization technicians and management staff.

During the research period four projects were analysed with the following general characteristics:

Table 1: Electrification projects analysed in Cajamarca (Peru).

Community	Technology	Installed power	Beneficiary households
Alto Perú	Micro wind network	2 Kw	11
Chorro Blanco	Micro hydro plant	20 Kw	37
Campo Alegre	Individual solar and wind energy hybrid	20 x 0.15 Kw	20
El Regalado	Micro hydro plant	12 Kw	31

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 the 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 the 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.

### *Methodology for project analysis using the Capability Approach*

The works of Alkire (2002), Biggeri *et al.* (2006), Frediani (2008) and Muñiz (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 capabilities expansion, particularly in gender issues.

The following table displays the methodology steps as well as the data required in each of the research phases.

**Table 2: Research methodology steps**

<b>Methodology step (place)</b>	<b>Data to gather</b>
1.- Literature review (Spain and Peru)	General project context and individual conversion factors (ICF)
2.- Interviews to key stakeholders (Peru: Lima and Cajamarca)	Context and ICF
3.- Workshops with Practical Action (Peru: Lima and Cajamarca)	Goods and services provided and ICF
4.- Transects (in the community)	ICF
5.- Workshops with leaders (in the community)	Project implementation process (access, participation, equality, organization, etc.), agency and context
6.- Participative workshop with beneficiaries (in the community)	Things valued by people, Capabilities and functionings
7.- Individual interviews (in the community)	Personal choice, personal history, capabilities, functionings and agency
8.- Feedback (to the NGO in Cajamarca)	Share and discuss the research results

The comprehension of the context (and the rest of conversion factors) was achieved through semi-structured interviews to key informants (Practical Action decision makers and technicians, staff from other Peruvian and foreign development NGOs and also to Peruvian University researchers and other key stakeholders in Lima and Cajamarca).

The main feature of the fieldwork was the fact that it was co-designed with Practical Action, from the research objectives to the workshops structure, the communities 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. The following table displays the main characteristics of the fieldwork in the communities with techniques used and their objectives.

**Table 3: Communities fieldwork**

<b>Methodology</b>	<b>Technique</b>	<b>Data to gather</b>
Focus group	Open questions on the electrification project and the community organization	Social conversion factors; analysis of the goods and services provided by the project.
	Timeline	Community history; project relevance for the community
Participatory workshop	Women's workshops and men's workshops	Things people value; relationship between the project and the things people value



	Ball dynamic	Find out the effects of the electrification project
Individual interviews	Semi-structured questionnaire	People's life history; Focus on individual capabilities; Find out relevant personal data related to the project process (participation, equity, access, organization, etc.); Find out agency related data (motivations, negotiation, participation in important decision-making, sense of community, etc.)
	Uses of time	Women chores and men chores (before and after the project)

The methodology has an important gender component. On the one hand, the participatory workshops took place separately in each community, one for women and another for men. On the other hand, 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 responsibility posts in the community, as well as about their access and participation in the electrification project.

The participatory workshops in the communities were the key methodology tool to obtain 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 not so much to find out about the capabilities of people but to find out the things people value to have 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. Finally the workshop ended with a group reflection on the project impacts on the things people valued.

It is important to highlight that more men participated in the workshops as compared to women. This is caused by the fact that generally the person 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 participating 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 problem was addressed adapting *in situ* the timings of the activities to the women's availability, and increasing the number and depth of individual interviews to women.

## **Analysis and discussion of results**

### *Extending the basis of information for the interventions analysis*

One of the key elements during the participatory workshops in the four communities was to find out 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; they also improve the access to communication through television and radio; provide the possibility of night study under appropriate light; allow the use of computers and audiovisual equipment in schools; and improve local medical centres equipment. On the other hand there is some cost saving for people as the cost of

electricity is lower to that of candles, kerosene, batteries etc. Finally the productive use of energy in local business such as restaurants, hostels and mills, can improve production and sales and thus constitute an economic benefit for the community.

The research confirms those benefits but also, using the Capability Approach, 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 find out 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 emphasised that the light made their community more attractive, reducing the emigration of the youth and enabling people from other communities to settle in the area. Also in El Regalado the participants felt that electric lighting had promoted a bigger 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 interventions.

We are interested in taking an in-depth look into the differences among 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) satisfied better 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 lighting or leisure lighting. Also the reliability and robustness of the hydro power systems entailed a greater satisfaction amongst the people, as compared to the wind or photovoltaic systems with less amount 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 that the hydro power projects did. As the technology is simpler, Practical Action does not create communal spaces for community participation, instead the NGO technicians perform their work in each household.

On the other hand in the two communities with by hydro power systems, the implementation processes took longer and the people participated actively in the construction of the infrastructure; men did building work (ie. channels) and women carried materials and prepare food. The fact that it is a type of technology which requires more labour than the others, has an impact on community participation and therefore in building a sense of community: '*We all together made it*' said a woman in El Regalado.

### *Gender inequalities in technology access*

The presence of light in homes increases the number of activities performed throughout the day but the type of activities is very different between the genders. For instance it is commonplace for men to watch TV 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. This could be considered a way of reproducing women roles and could

contribute to the inflexibility of social and cultural structure, which preserves gender inequalities. But women affirm to be happy to be able to complete these chores and thus improve their families' welfare. Are we facing a woman's adaptive preference to sacrifice her own personal wellbeing for her family? The research results in this respect are not very clear though we can state that men are freer to choose how they spend the extra time provided by the electricity supply.

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 do not enjoy this possibility 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 issues such as developing their spiritual life.

The research also shows inequalities in the opportunities to participate in the community. Women express their lack of time or chances to attend meetings or assemblies at the time 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 like the one by the APAFA President (a parents association) in Chorro Blanco who explains why she does not talk 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 before, the project applies two types of training: one directed to the final users and another to the operators and administrators. In the first one, it has been observed that the acquisition of technical knowledge about the electrical systems improves the population 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. On the other hand in the cases when women claim having learnt something about the operation or maintenance of the systems it is because their husbands taught them: '*Only my husband took part on 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 it is the type of training which 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*', these are some of the answers given by the interviewees who were receiving training to be operators or administrations in the community. However women do not have access to these responsibility posts 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, 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 with 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 agency. In some cases, there are indications of the potential of training to strengthen agency. This is the case for the Major 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 trainings, their agency improvement will not take place.

## **Recommendations**

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 in their diagnosis. Presently, and following the World Bank recommendations, they gather socio-economical quantitative information. This has proved not be insufficient and it would be appropriate to gather information about values, customs, gender roles, leadership in the community among others. This means that Practical Action technicians need to have the skills required for this. Therefore, an intra organization training plan should be started for the short and mid-term.

It is also necessary to increase the community participation in the diagnosis and the technological choice. These tasks have been carried out so far by Practical Action, selecting individual or collective technological alternatives based on their own criteria. But we believe that it would be possible to organize training activities to provide community members with information about the identification and management of natural resources through technology. These workshops could be open not only to men but also to women and young people using specific strategies for each group.

Likewise, regarding the project design, we recommend including specific activities to deal with gender problems with an allocated budget to ensure the availability of resources during the project implementation. It will also be good to have specific gender indicators to assess the projects success in this respect.

Regarding the project implementation, we have identified low levels of attendance to meetings and community assemblies due to timetable incompatibilities with the work duties of most community members, as so far the meetings were planned by Practical Action staff. To solve this problem, we would advise that the community itself defines the timings of the meetings, and Practical Action staff adapts to them instead of the other way round. In particular it would be very useful to appoint a female coordinator to plan the meetings with Practical Action and in doing so take into proper consideration women's availability. This responsibility would also increase her agency.

In addition, it would be convenient to organise separate meetings or workshops for men and women to ensure women's participation, as it has been proved that power imbalance inhibits women from publicly expressing their personal, political or ideological opinions. Another suggestion is to 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 participate actively in the meetings.

Another type of useful training to incorporate to the projects for both men and women could be on community leadership, rights, gender inequalities, environmental issues and project management.

Regarding the management of the system, it is advisable to include women in the responsibility posts. 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 women. This would help the community realise that women can perform both in technical and responsibility posts, improving in this way women's agency. The same way to proceed could be applied to the construction of infrastructure or the installation of energy systems where women should also become visible and perform the same tasks as men.

Likewise, it would be interesting to set up a local monitoring committee to verify the compliance with the goals established during the project design. This would increase the participation and the ownership of the project by the community. Again, this measure could give more visibility to women if they were included in this committee.

Finally, the fact that local Governments contribute to the budgets of the projects is important opportunity to increase agency. It should be used to open a space for discussion between the community and the local governments and reinforce the collective agency of the communities.

### **Conclusions.** *Technology: necessary but not sufficient for development.*

This research has revealed the limitations of interventions directed to supply technology, electrification in this particular case, that don't take into account certain elements which 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 should be urgently addressed by Practical Action when planning their projects.

The Capability Approach provided us with further elements of analysis that refer to the importance of the process during the project development. It is important to ensure the participation of the community in the different phases of the project, making sure that women are included.

This research has also certain limitations. It has not analysed, for instance, the development of children's capabilities due to time and resources limitations. 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 to use all the potential of the Capability Approach for development.

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