

## A NEW EVERY-DAY LIFE



## Summary of the survey on socio-economic impacts of rural electrification in Morocco





*«... la problématique sociale, qui constitue, pensons-Nous, le défi majeur à relever pour la concrétisation de notre projet de société et de développement. En effet, Nous avons décidé, avec l'aide de Dieu, de Nous y atteler en lançant une nouvelle initiative qui se veut novatrice et ambitieuse, à savoir : « l'Initiative Nationale pour le Développement Humain ».*

*« Nous avons également veillé à la disponibilité des moyens et des mécanismes à même d'impulser le processus de développement – notamment le Fonds Hassan II pour le développement économique et social – et d'accélérer la réalisation des programmes nationaux d'adduction d'eau potable, d'électrification intégrale du monde rural et de son désenclavement. ».*

Extrait du discours de Sa Majesté le Roi Mohammed VI à la Nation (Rabat, le 18 mai 2005) à l'occasion du lancement de l'Initiative Nationale pour le Développement Humain.





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## Development of some of the acronyms used in this survey

<b>DWS</b>	:	<b>Drinking Water Supply</b>
<b>ONE</b>	:	<b>Office National de l'Electricité [National Electricity Board]</b>
<b>SPC</b>	:	<b>Socio-Professional Category</b>
<b>Elec</b>	:	<b>Electrified</b>
<b>EV</b>	:	<b>Electrified village</b>
<b>NE</b>	:	<b>Non electrified</b>
<b>NEV</b>	:	<b>Non Electrified Village</b>





# INTRODUCTION

In addition to the implementation statistics in villages, the Global Rural Electrification Program is currently changing economic and social data of rural Morocco. The aim of these changes, thus introduced, is to increase the contribution of rural communities in the development process and to bring them closer to the cities' way of life. However, electrification alone cannot relieve isolation and achieve investment servicing in rural areas. The effort must be shared, as part of what is called the strengthening of impacts, with other industries involved in basic infrastructure, health, agriculture, handicrafts and local industries.

Following studies in 1987 and 1999, the ONE initiated, in 2003, a third impact study of rural electrification, in its different forms, on households, non-domestic users, rural locations and on the natural environment. The purpose of this survey, which has lasted over a year, is to enable the ONE, on the one hand, to analyze, review and update previous impact studies, and secondly, to evaluate direct or indirect impacts caused by rural electrification, in time and space, on these categories, based on a thorough analysis of the realities in the field. The specific effects of RE could thus be isolated from those induced by other factors, and elements used to calculate the profitability of the PERG (Programme d'Electrification Rurale Global) [Global Rural Electrification Program] could be updated. These impacts have been observed throughout 3 main areas of analysis, namely the economic, social and environmental aspects at individual, local, and global level.

### **Effects demonstrated on crafts and commercial activities, and on employment**

Interviews in the field have shown that rural electrification is not neutral. It has globally and economically speaking an impact on the development of craft activities requiring the use of productive electrical appliances, specifically perceived in terms of extension of the working time.

This survey shows that electrification has a significant impact, particularly in terms of development of commercial activities in the villages. Without any doubt, the number of businesses is growing with electrification.

The other economic aspect relates to households' energy expenses. The decrease in these expenses hits specifically extreme classes (the richest and the poorest), whereas middle classes are increasing their expenses due to rising comfort provided by electricity.

At global level, the effects of the PERG on employment are undoubtedly positive with 14 000 new direct jobs (construction business, installers, electricians...). It should however be mentioned that jobs were mostly created in urban areas or urban peripheries.

## **The Audiovisual Communication – a Major Player in the Cultural Transformation of Rural Society**

At social and individual level, electrification has brought about a significant improvement in the comfort level of households through an impressive distribution of comfort facilities.

The massive spreading of audiovisual communication through electrification is an opportunity to reach out more broadly to rural areas with educational programs. Incidentally, drastic changes are also expected to occur in consumption patterns and in the lives of Moroccan rural populations in the coming years with urban models being broadcasted on television.

The positive impact is also improving indicators of children schooling, especially girls. The dropout age of girls was extended and their schooling rate could be improved. Emigration and rural exodus were also reduced by about 5% and the return rate to the villages increased by about 1.5%. However, this impact remains sensitive and limited to some ten years. The slowdown in the exodus is also heavily dependent on other factors such as the existence of infrastructure in the village.

Unquestionably, electrification has strengthened the feeling of safety in villages and improved social togetherness with street lighting.

Finally, electrification of dispensaries is an asset that has helped to improve health services and health care in rural areas by providing opportunities to use more sophisticated medical equipment and facilities for childbirth.

### **Life Conditions are improving in Electrified Villages**

At an individual level, electrification brings about a significant increase in the rate of masonry construction and internal replanning of habitat, which is often disorganized in the absence of urban planning for rural areas. At the local level, the electrical grid clearly constitutes a structuring equipment that has an impact on the development of villages. In some contexts, electrification is accompanied by an increase in the price of land.

In terms of emissions, rural electrification has significantly reduced battery discharges in the local natural environment.

Finally, it is important to mention that the impact on landscape along with the deployment of electricity networks in the villages is not perceived by the population as a critical issue.

The other important aspect analysed in this study is the profitability of the PERG for the various players. For the consumer, it is estimated at 21.4%, reflecting the general economic advantage induced by RE.

## **The Strengthening of Impacts: Towards an Integrated Approach**

One of the facts revealed by the survey is that the impacts of rural electrification are determined by other important development factors: economic and socio-cultural factors, road infrastructure, saving and financing capacities ...

To reinforce the impacts induced by rural electrification, accompanying measures are needed, involving partnerships with other sectors impacting on the local development (basic infrastructure and financial institutions). Other partnerships will accelerate the economic development of electrified zones and the subscription rates of users by reducing financial barriers related to a lack of household savings. They include namely those to be entered into with financial institutions to facilitate the financing of credits for electrical installation or production equipment, as well as initial participations in electrification operations.

## **The Rural Electrification Development Plan (VER Plan) to foster Greater Impacts of the PERG**

The electric infrastructures achieved by the PERG in rural areas to generalize electrification (more than 150 000 km of low voltage and middle voltage) offered them a great development potential which will allow improvements in rural areas.

Thus, and the eve of the end of the PERG, the ONE launches the Rural Electrification Development Plan (VER Plan).

The VER Plan meets in its spirit and initiative a value which the ONE develops more, that of the social responsibility. Its mission of public utility takes a new dimension which illustrates its creed: Energizing Morocco's Growth.

### **General objectives of the Plan**

The VER plan leans on a triple valuation that of valuation of assets, services and experience.

#### **Valuation of assets:**

- Identify and promote income generative activities in rural areas in agriculture and out of except agriculture as well.
- Contribute to the development of national and regional projects (irrigation, industrial frost, rural tourism...)
- Promote collectivity use
- Develop the use of networks for services other than energy transmission
- Facilitate access to electricity to poor families

#### **Valuation of services:**

- Improve convenience services
- Develop partnership with actors working in rural areas
- Generalize the use of prepayment
- Value the database of the geographical information system

### **Valuation of experience:**

- Share and value the acquired experience within the PERG at the national level (PACT program, National Initiative for Human Development program INDH ...) and at the international level as well.

### **Management structure of the Plan**

To lead this project, a Rural Electrification Development Management was set up. Its mission is to conceive and implement the VER plan.

The regional Managements of ONE spread locally the plan, assure the relay with the regional partners and follow the realizations. They are responsible of increasing the number of productive customers.

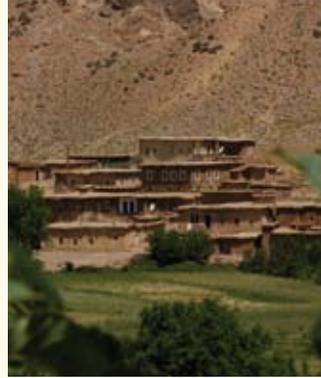
The socio-economic vocation of the VER Plan and the imperative of its opening on its environment led ONE to set up a committee consisted of personalities outside the ONE and recognized for their commitment in the social development action. Its mission is to accompany the ONE in the implementation of the plan, the elaboration of its important orientations and its realization. It will contribute to identify and develop the synergies with the various actors acting in the rural world and to insure the convergence with the various programs led by the State.

### **The partners of the Plan**

The realization of the VER plan will be led in partnership with actors concerned by rural development and who can join ONE in this initiative.

- Ministerial departments acting in rural development: agriculture, crafts, tourism...
- Non governmental organisations acting in rural development and micro loan institutions,
- Universities,
- Financial institutions,
- National and regional development agencies,
- International organisations,
- Local collectivities





**GENERAL  
BACKGROUND**

## **2.0 . International Background**

The widespread economic crisis which marked the end of the eighties has forced most developing countries to reduce their rural electrification program to minimum. Only a few countries, such as Indonesia, India, Brazil, Argentine, Tunisia, and Morocco, have been able to maintain their programs.

Given the nature of public service attributed to rural electrification, it seemed obvious that only beneficial effects would be produced and the desire to examine and to measure the impacts was not a genuine concern for governments or for donors.

However, two experiences deserve to be mentioned in that field. A study conducted in the Philippines in 2001, introduced innovation with regard to the recommended methodological approach to assess the impact of rural electrification much more on a quantitative base than in the past. A second study conducted in Vietnam was aimed at highlighting how the impacts of electrification change over time (time effect).

## **2.1 . National Background**

According to the strategy of continuous improvement of its intervention modes, the ONE had already conducted 2 studies: one in 1987 and the other in 1999.

The impact study of 1987 was one of the few large-scale works carried out in the world at that time. It also had the merit to serve as the first baseline of impact indicators, particularly as regards the quantifiable aspects, such as the impact on subscribers' energy expenses.

The impact study of 1999 occurred during the effective launch of the rural electrification process in Morocco. The main motivation was to provide the necessary elements for decision making as a guideline for the approaches to be adopted in the following crucial development phases of the PERG (Global Rural Electrification Program).

In the same way as in the study of 1987, the analysis was based solely on simple cross-checking, and did not make use of advanced analytical methods such as statistical classifications and multidimensional analysis.

Following the significant acceleration in the pace of electrification under the PERG, leading to an increase of the annual number of electrified households from 100 000 to 150 000, the ONE launched, in 2003, a third impact assessment of electrification in its various forms, on households, non-domestic users, rural communities, and the natural environment.

The analysis of these issues was made at three levels, the individual level, the level of the douar (small village) and its surroundings, and the global level.

The study represents, at the international level, one of the first major works on the impact of rural electrification at country level, using statistically high-performing multidimensional analysis methods.

It also offers the opportunity to follow in time a panel of villages on the base of a reference situation characterized by the surveys.





**APPROACH AND  
METHODOLOGY  
OF THE SURVEY**

### **3.0 . Survey (Data Sources)**

The field of survey covers 6 types of sub-surveys or methods of survey: surveys on “households”, “non-domestic subscribers” (formal and informal professional sector); “public services”: schools and nursing stations, and “villages”, based on the technique of focus groups with key people in the village. Gender related focus groups were also set up: young men, young women, adult men, adult women, and «case studies», as a second step after the interviews, to probe certain topics considered interesting.

These surveys were based on questionnaires and interview guides incorporating economic, social and environmental issues as well as the respondents’ perceptions of the impact of the alleged rural electrification.

#### **3.1 . Sampling (Villages and Households)**

The sample was drawn according to a number of criteria, among which the most qualifying were:

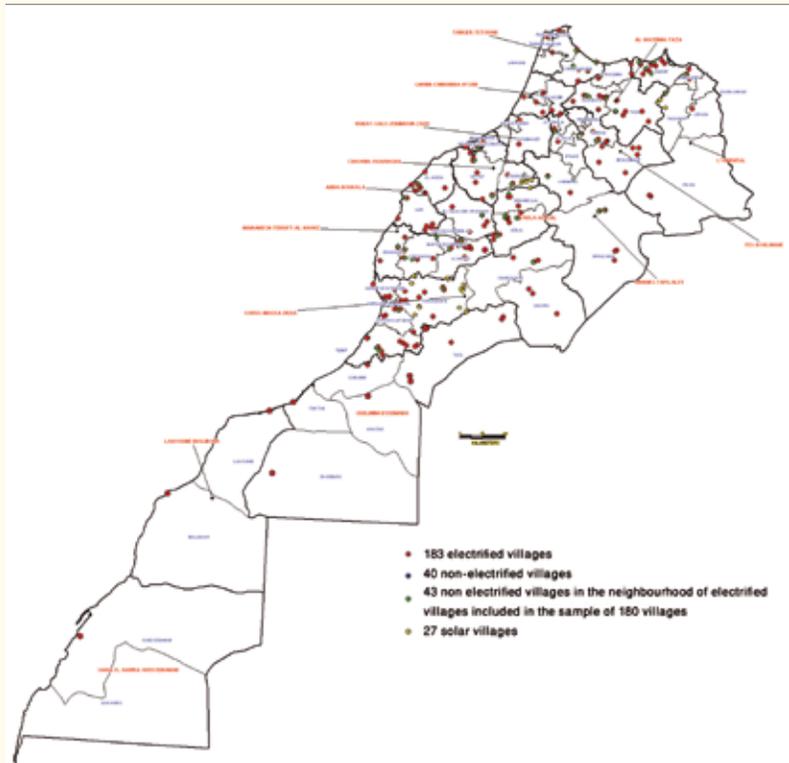
- Geographic situation;
- Regional situation;
- Size of the villages;
- Degree of isolation;
- Socio-economic level;
- Electrification mode;
- Electrification date.

On other criteria, a random selection allowed to ensure the representativeness of all the other criteria considering the large number of villages.

Thus, the survey has covered, according to the selected criteria, 293 villages, out of which 183 network electrified, 83 non electrified, out of which 43 in the neighbourhood of 43 electrified villages and 27 villages equipped with photovoltaic kits, i.e. representing approximately 2000 respondents in 53 provinces involved.

Finally, to make sure to have a significant representativeness of the sample for a sound statistical analysis, the necessary corrections have been made according to the effective situation of rural Morocco as described in the database of the ONE (particularly with regard to the size of the villages and the date of electrification).

## Distribution of the villages surveyed in the Kingdom



And so we introduced sizes of villages from 30 to 49 homes, representing types of villages including between 6 and 74 homes; villages including between 100 and 130 homes, representing types of villages including between 75 and 164 homes; and villages between 200 and 260 homes, representing types of villages including between 165 and 400 homes.

### Structure of the survey sample

Categories of respondents	Conventionally electrified douars	Non electrified douars	PV electrified douars
Electrified households	3 households / douar	Not applicable	3 households / douar
Non electrified households	2 households / douar	2 households / douar	2 households / douar
Non domestic subscribers	1/3 of the subscribers	1/3 of the subscribers	1/3 of the subscribers
Services	Comprehensive	Comprehensive	Comprehensive

## 3.2 . Data Processing and Analysis

To evaluate the questionnaires, a database has been created to gather all the elements from all the carrier variables used to facilitate processing, to avoid ambiguous interpretations and to ease the correction of any ambiguities.

The data obtained from the focus groups were divided into two types: written data from the guides and data stored on tapes. In rough format, the data were the direct transcription of conversations that took place in the focus groups (men and women). An expert in sociology made the transcription of these conversations including an open type of questions and answers into a closed type of questions and answers. The data recorded covered the integral conversations held by ten focus groups. Taken together, these recordings were transcribed and translated into a closed-type text.

Before proceeding with the data processing, a thorough audit focused on entry errors and faults in fact sheets, as well as on tests of global uniformity and soundness of the database.







**IMPACTS OF  
RURAL  
ELECTRIFICATION**

Although a number of direct effects such as household equipment or the rate of electrification of a village can be measured without ambiguity, other effects induced by rural electrification are typically indirect effects and might be confused with other effects associated with the simultaneous development of other infrastructure (roads, schools, clinics, drinking water), or related to sociological and cultural developments in the rural world.

One of the characteristics of the rural world, especially the Moroccan rural world, is that it is undergoing rapid changes dictated by the urban world disseminating its consumption patterns, cultural and sociological developments, as well as its modes of production (technological transfers) through an “oil spot” process, i.e. concentric process, centred around cities and amplified along the main lines of communication.

For this reason, any impact study or more broadly any attempt to explain socioeconomic behaviour related to a particular phenomenon, and dealing with the rural world, faces its specific methodological difficulties, which explains why so few studies on the impact of rural electrification have been conducted throughout the world.

In this case, the socio-economic impact study is a pioneer work, which is sometimes close to basic research. The aim of this study is to help isolate the real impact of rural electrification, which means indirectly to eliminate the effects related to this “oil spot” dissemination of urban behaviour.

For example, electronic data processing of the interviews (statistical research studies) showed that for a number of indicators, electrified villages were at the top of the list, followed by non-electrified villages and photovoltaic villages.

Photovoltaic equipped villages often ranking in the last position proves that these changes cannot be attributed solely to electrification, because in this case the photovoltaic villages should hold at least equal positions with non-electrified villages. That does not mean, however, that electrification has not played an accelerating role.

In fact, the survey shows very clearly that the electrification process itself led to the electrification of villages that are better serviced, bigger, better equipped with infrastructure and therefore already richer than others. This is also the reason why photovoltaic villages, usually very small and landlocked, are often ranking in the last position for a number of indicators. The same goes for the electrification of households: undeniably, the richer households are more often electrified than less affluent households.

We must therefore be able to compare the effects «everything else being equal», that is to say by isolating the effects of wealth, easy access, the size of villages, infrastructure, and even local economic resources (agriculture and livestock) related to the nature of the soil and climate characteristics.

In the following, we developed several independent multivariate analysis studies that allow to isolate by way of cross-check information a number of effects (or «non-effects») of rural electrification.

These tests have the advantage of relying on sound and undeniable statistical results. They do not rely as such on perceptions of the respondents; however they use these perceptions to clarify the analysis.





**ECONOMIC  
IMPACTS**

The study showed that rural electrification impacts the overall economic situation. This is not surprising, given that the development of craft activities requires the use of productive electrical appliances. Traditional crafts are however little affected and the impact is seen particularly in terms of extension of working time.

The study shows incidentally that electrification has a significant impact in terms of development of commercial activities in the villages. The number of businesses is unquestionably growing with the advent of electricity.

The energy expenses of households grow or fall depending on the circumstances. But in general, there has been an increase in energy expenses of the middle class because of the improved level of comfort provided by electricity.

At the global level, the effects of the PERG on the employment have been very positive and have resulted in the creation of direct jobs (construction companies, INSTELECS...), mainly in urban or suburban areas and direct ones as well.

## **5.0. Income of Households**

To eliminate the socio-economic impacts (sources of household revenues, level of wealth, etc...), it seemed necessary to develop a statistical classification to help creating a socio-economically homogeneous household typology similar to socio-professional categories (SPC) used in conventional household surveys.

The impacts were then calculated for each SPC to isolate the effects of electrification.

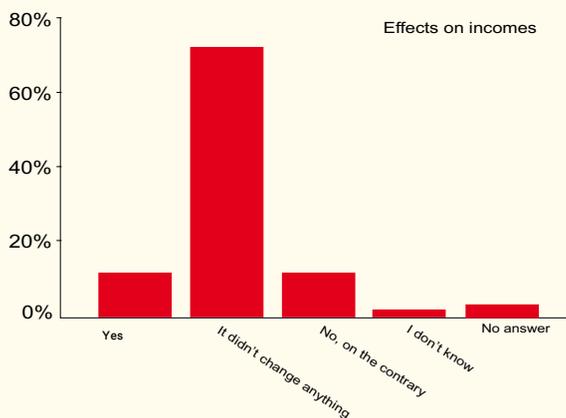
Chart 2. Socio-professional categories and their distribution

Main activity	Category	Rate of interviewed persons	Number of persons
<b>1 – Agricultural</b>	11 – Large scale farmers	4,2 %	51
	12 – Middle scale farmers and livestock breeders	7,8 %	94
	13 – Small-scale farmers and livestock breeders	16,7 %	202
	14 – Farmers or livestock breeders with domestic activities	8,2 %	99
	15 – Farmers and farm workers	14,4 %	174
	16 – Households with handicraft capital	9,8 %	119
<b>2 – Non agricultural</b>	21 – Literate employees	7,4 %	90
	22 – Workers (agricultural or non agricultural)	18,9 %	229
	23 – Households living on revenues from emigrants	12,3 %	149

Approximately 12% of network electrified households felt that electrification was one of the reasons for the improvement of their income.

This increase is largely determined by the types of households. Households benefiting most from the effects of electricity on income are primarily households with a craft activity; 1 out of 3 reported that their incomes increased after the electrification. This increase is relatively immediate and persistent.

Figure 1. Perception of the effects of electrification on the increase of household income



## 5.1. Development of income-generating domestic activities

Electrification has promoted the development of economic activities, particularly mechanical or electrical activities and businesses.

Small income-generating activities (upholstery, sewing) are not affected by this development as opposed to craft activities using productive capital (typically mechanical).

22% of craftsmen who have a dual activity (crafts and agriculture) perceive an increase in their incomes, while 46% of those with craft activity solely (twice as much) perceive an increase in their incomes after electrification.

While mills and oil crushing operations are the economic activities least stimulated, mechanics (50% report having developed), commercial activities (35%) and other crafts such as blacksmith, repair shops, etc., are the activities with the highest growth rate.

**Chart 3. Perception of the increase in income by own means of small-size production**

Higher income?	Production means						
	Mill	Oil mill	Mechanics	Commerce	Other	No answer	Total
Yes	33%	20%	50%	35%	40%	7%	12%
It didn't change anything	17%	53%	50%	46%	53%	77%	72%
No, on the contrary	50%	13%	0%	11%	0%	11%	11%
I don't know	0%	13%	0%	2%	0%	1%	1%
No answer	0%	0%	0%	6%	7%	3%	3%
<b>Total</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>

With regard to domestic production equipment (for the development of crafts or income-generating activities), 3% of the households covered by the survey had acquired a sewing machine, a milking machine, storage equipment or other productive household appliances.

In conclusion, electrification has an overall impact on the development of craft activities requiring the use of productive electrical appliances. However, there are still structural barriers related to the difficulty of acquiring some of these devices.

While traditional handicraft remains only lightly affected by these changes, it should be mentioned that they are more common in rural villages and therefore more represented in mainly rural villages not yet electrified. Strong future impacts of electrification can therefore be expected if it is accompanied by adequate measures: financing and marketing of products.

Households with income generating domestic activities dedicate more time to these activities after electrification. This phenomenon is significant and estimated at an average increase in working hours of 25%, or 1 additional hour on average.

This increase is consistent at the beginning of the electrification and decreases with time, reflecting a learning process in households.

Some of these electrified households take advantage of the night time to work: 56% of network electrified households as opposed to 41% of non-electrified households, i.e. a 15% increase in night work.

## **5.2. Development of Businesses**

The impact on trade has been appreciated through three indicators: longer working hours in the evening, increase in revenues and diversification and expansion of the scope of activity.

For the first indicator, 37% of the traders perceive a strong impact of electrification on the extension of opening hours of their shops in the evening, and as many perceive an impact, but they feel it is less important.

About 72% of the traders believe that electrification has enabled them to increase their income (see chart below). This effect is explained through several phenomena: extension of working hours, diversification of sold products (dairy products, fresh produce, chilled beverages, etc.)

### **« Does electrification improve income? »**

Approximately 26% of electrified businesses feel that their activities have expanded «a lot» and 30% «a little» through electrification. It is worth noting that some businesses think that it has limited the scope of their activities, probably because of increased competition from other businesses.

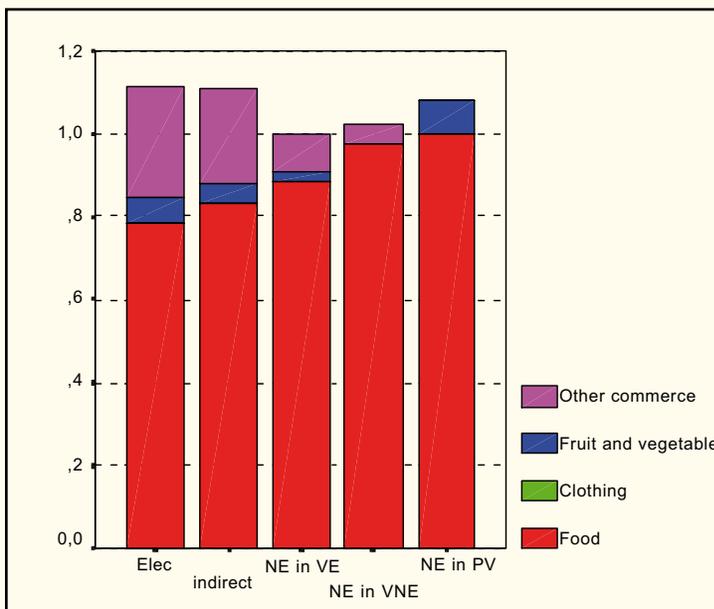
In conclusion, the majority of electrified businesses perceive a positive impact of electrification:  $\frac{3}{4}$  are working in the evenings thanks to electricity and have experienced an increase in their income. More than 50% have expanded their activities.

Multidimensional statistical analysis allows to largely corroborate these perceptions:

- The average opening time of businesses increases from approx. 6 hours per day in non-electrified villages to approx. 10 hours in electrified villages.
- In accordance with the perceptions, electrification is accompanied by an increase in the variety of trade types
- Electrification is increasingly becoming a key element in the creation and sustainability of businesses. The survey showed that the overall business activities established in the 2 years (2002 and 2003) have been created while the owner already had electricity. This shows the undoubtedly accelerating effect of electricity in creating businesses.
- There clearly is a difference between the level of equipment in businesses in electrified villages and those in non-electrified villages. Particularly for refrigerators, the equipment rate is 60% for the first and 15% for the second category.
- As a general rule, the situation in PV villages is quite similar to the situation in non-electrified villages. The observed equipment rates are very low.

**Figure 2. Type of business by type of electrification**

in % of the total of each type of electrification – the total is higher than 100% as there can be several commercial activities



Multidimensional analyse based on the measurement of the intensity of commercial activity in the villages showed a variation of the impact of electrification on business depending on the context of the village. (Village in a rich or average agricultural area, well serviced and equipped with infrastructure or farming village, landlocked and sparsely equipped or small).

### **5.3. Development of Small-Scale Industries**

With regard to handicrafts, new activities most frequently quoted in the focus groups are essentially welding, carpentry, mechanics, and grain mills. Electrification, according to the statements of respondents, has also allowed the creation of tailoring, embroidery, clothing, and knitting activities, etc.

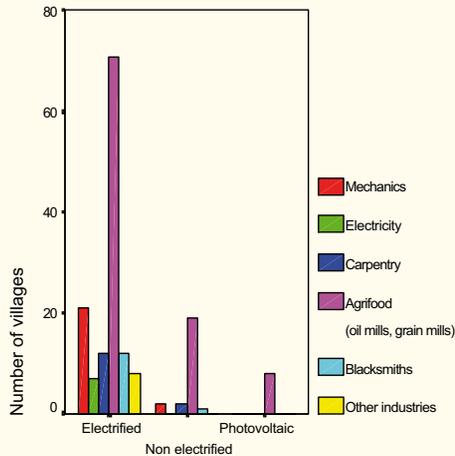
Indeed, three types of activities, all related to handicrafts, are covered by this part: traditional craftsmanship activities (weaving, leather, etc.), activities of small-scale industries (engineering and carpentry workshops, mechanical repairing, etc.), and activities related to the processing of agricultural products (grain mills, oil mills, etc.).

In terms of perceptions of impacts, surveys have shown that 16% of electrified villages perceive a positive impact of electrification on the development of crafts. However, 80% of non-electrified villages believe that electrification would develop crafts in their villages.

Surveys on craftsmen have revealed the following perceptions:

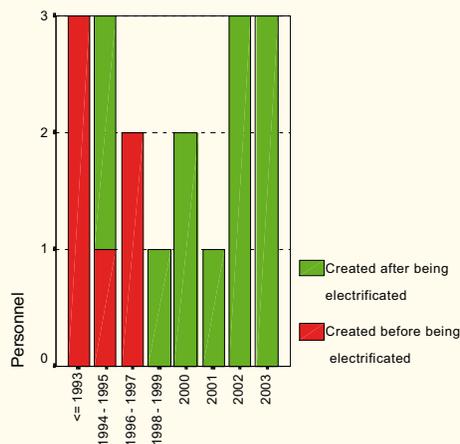
- More than 2/3 of electrified craftsmen respondents believe that electrification enabled them to work later in the evening, and 3/4 feel that electrification has improved their turnover. Of the latter, approx. 1/3 believes that this increase is significant;
- More than 70% of electrified non agro-food industries believe that electrification has expanded their business. 1/3 of them believe that this expansion is very significant.
- The average subscription rate of small-scale industries in electrified villages is approx. 57%, while in non-electrified villages, the rate of industries using electricity (self-production) is only around 4%.
- In network electrified villages there is also a greater diversity of industrial activities in electrified villages, as shown in the following figure:

Figure 3. Number of villages with at least one specific industry



- The following graph shows that, in general, industrial activities created over the last 6 years (1998 to 2003) were created while the owner already had electricity. This undeniably shows the accelerating effect of electricity on the establishment of small industries.

Figure 4 : Distribution of industries by years of start-off and according to whether or not they had electricity at the time of inception



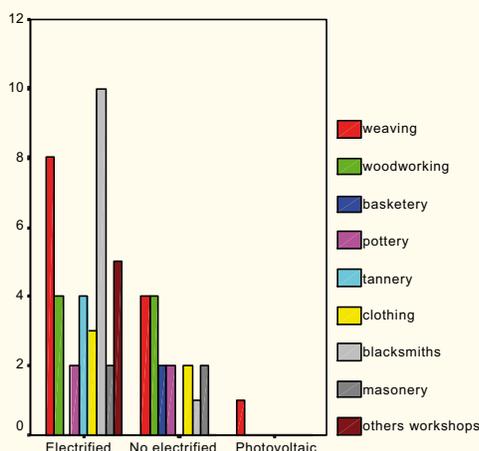
- Globally seen, electrification has a stronger positive impact on the development of small industries than of traditional crafts. The first category, particularly non-food industries, has technical assets allowing them to seize the opportunity presented by electrification. The impact on small-scale industry remains dependent on the context of the village (size, resources, degree of isolation, presence or not of infrastructure ...)

## 5.4. Development of Traditional Crafts

Multidimensional statistical analysis allowed qualifying and clarifying relative outcomes by identifying key lessons:

- The subscription rate of traditional craft workshops is approx. 66% in electrified villages. In non-electrified villages, some workshops use their own means of power production (generators, batteries, etc.). They account for 6% of the existing workshops.
- In network electrified villages, handicraft branches tend to diversify, as shown in the following chart:

Figure 5. Number of villages with at least one specific workshop



- However, the analysis shows that the impact of electrification on the development of traditional crafts remains largely marginal. The focus groups also felt that the impact requires an «incubation» delay before it appears.

## 5.5. Development of Agriculture

In the field of agriculture, new activities have developed through electrification, according to local talents and potential:

- Modernization of cattle breeding: equipment and maintenance of barns; night monitoring of nutrition; introduction of milking machines; creation of milk collection centres and dairy cooperatives;
- Electric pumping for irrigation along with the intensification of certain crops, but also with the emergence of new agricultural speculation;
- Modern poultry and refrigerators for storage and packaging of fruit and horticultural products.

However, the impact of electrification remains conditioned by a number of factors such as isolation, trade opportunities, level of infrastructure equipment in villages, potential of local natural resources (land, water, forest resources and pastures, etc.), access to funding (credit, capital, etc..).

## 5.6. Creation of New Economic Activities

Some 20% of network electrified villages believe that electrification has led to the creation of new activities in the village. This figure is somewhat lower in the PV villages (16%).

The new activities created primarily affect trade. The trade of new food products has grown with the acquisition of refrigerators by the merchants. Those most frequently quoted are sales of milk, cheese, yogurt, meat, beverages, fruit juices, etc...

The creation of cafes and restaurants was also mentioned in the interviews as an impact directly related to electrification.

Chart 4. Impacts on the development of new activities

Type of village		Development of new activities		
		No	Yes	Total
Electrified	Number of persons	144	35	179
	% in Type of village	80,4%	19,6%	100,0%
Photovoltaic	Number of persons	21	4	25
	% in Type of village	84,0%	16,0%	100,0%
Total	Number of persons	165	39	204
	% in Type of village	80,9%	19,1%	100,0%

### 5.6.0. Enterprises, Installers and Jobs

At macroscopic level, these impacts are related to the jobs created and developed by the rural electrification work in the enterprises in charge of carrying out these works, of the craftsmen responsible for internal connections and facilities and at the very level of the ONE.

For construction enterprises, the situation of permanent jobs is an average of 50 permanent workers for line installation works accounting for 10 000 000 DH and 3.5 permanent executives for line installation works accounting for 10 000 000 DH.

Based on the years 2002 and 2003, approximately 8 000 permanent jobs, out of which 500 for executives, are created each year through the work for the PERG. This involves some 40 000 individuals including families.

Approximately 5 760 craftsmen have been approved by the ONE and had therefore the opportunity to work in the market created by rural electrification. The figure of 6 000 direct jobs (in «full time» equivalent) is advanced as being generated by the PERG through interior installation work.

At the ONE, the direct impact of the PERG on employment involves almost 800 people (REO, EA and SR), more than 11% of the ONE staff assigned to production and transportation activities.

In conclusion, it was found that the effects of the PERG on employment are undoubtedly very positive. However they must be qualified by the fact that the jobs are mainly created in urban areas or urban periphery.

Considering indirect jobs and new economic activities created at the local level, the total number of jobs would then be between 18 000 and 22 000.

## 5.7. Energy Expenses

Overall, electrified households benefit from a reduction in their energy costs. In fact, about 55% of households connected to the grid believe that their energy expenses decreased after electrification. This share accounts for some 40% in households equipped with solar panels.

On the other hand, there are also some slight, yet meaningful differences in the perception of the change in energy expenses:

- 1 electrified household out of 4 perceives stagnation or an increase;
- Only 1 non-electrified household out of 20 in a non-electrified village anticipates a similar development.

**Chart 5. Monthly household energy expenses in DH for specific uses of electricity by electrification situation**

	Type of household					Total
	Electrified	NE in V E	NE in V NE	NE in V PV	PV in V PV	
Petrol for lamp	0,16	4,24	8,61	1,02	0,43	2,38
Gas for lamp	0,02	18,19	27,20	16,92	1,53	9,04
Batteries for flash-light	2,67	9,24	11,65	8,92	6,16	6,01
Candles 0.47	0,47	21,43	17,84	14,83	4,00	8,79
Batteries for radio	0,21	17,59	19,51	25,58	8,52	8,74
Recharge for TV battery	0,00	5,29	9,85	3,21	0,00	2,80
Gas for refrigerator	0,07	0,43	3,80	2,64	1,49	0,89
<b>Total 1</b>	<b>3,60</b>	<b>76,40</b>	<b>98,47</b>	<b>73,13</b>	<b>22,14</b>	<b>38,65</b>
Pumping fuel	49,55	9,34	91,05	3,21	5,00	40,88
<b>Aggregate total</b>	<b>53,15</b>	<b>85,74</b>	<b>189,52</b>	<b>76,34</b>	<b>27,14</b>	<b>79,52</b>

The study showed that there is a difference between pumping fuel expenses in network electrified households and non electrified village households (50 Dh/month, compared to 91 Dh/month). But the interpretation of this difference is complicated as it may not fully result from electrification to the extent that the use of pumping is associated with other characteristics independent from electrification: isolation, size, level of infrastructure.

Expenses for thermal uses average 131 Dh/month/household. This average is relatively higher among network electrified households than among other categories of households (except for the non-electrified households in PV villages).

**Chart 6. Monthly household expenses in DH for thermal uses  
(in DH/month/household)**

	Type of household						Total
	Electrified	NE in V E	NE in V NE	NE in V PV	PV in V PV		
Petrol	0	1,02	1,62	1,33	0	0,52	
Small bottle of gas	33,4	33,38	34,74	35,09	33,18	33,63	
Big bottle of gas	77,83	53,32	77,1	56,5	57,75	69,73	
Charcoal	5,53	3,79	5,48	4,02	4,11	4,96	
Wood (commercial)	26,63	12,03	15,47	53,16	16,53	22,16	
<b>TOTAL</b>	<b>143,39</b>	<b>103,54</b>	<b>134,41</b>	<b>150,1</b>	<b>111,57</b>	<b>131</b>	

Overall energy consumption of electrified households is significantly higher than electricity consumption of non-electrified households, whether in electrified or non-electrified villages.

However, multivariate analysis has helped to refine and fine-tune these results according to socio-professional categories. It shows that average energy costs generally do not change before and after electrification. We can show that in the early years of electrification they decreased, but that they are rising rapidly to be higher after 5 years following electrification.

The richest categories experience a decrease in their energy expenses; this can be explained by their propensity to pay a high price for an energy service before electrification: electricity comes to lower the cost of the energy service.

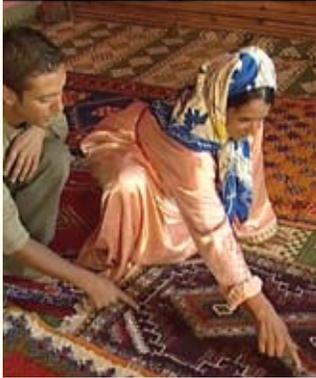
It is the opposite case for the middle categories (average farmers, craftsmen, households with main income from emigration), and the workers category, who experience an increase in their expenses. This is linked to the dynamics of equipment in these categories of households.

Finally, expenses stagnate in the categories of small farmers / ranchers (relatively poor categories whose equipment dynamic remains moderate), as well as agricultural workers and farmers.

Thus, the change in total energy expenses of a household is not systematic. According to the household's socioeconomic status, there may be an increase, decrease or stagnation of its budget.







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## 6.0. Emigration and Rural Exodus

Emigration or rural exodus is one of the possible impacts and one of the effects wanted by governments when launching a rural electrification program.

The problem of emigration is very complex as it depends on several factors such as:

- Distribution and location of employment areas;
- Global phenomena, such as the increasing concentration along the Moroccan coast of the population emigrating from the inland territory;
- Agricultural specialization: certain areas are naturally cleared as their competitiveness (in agriculture), is no longer sufficient in an increasingly open market, which causes an increasing decline in the density of farmers and ranchers;
- cultural phenomena, fuelled by the dream of a better world, symbolized by the city and foreign countries;
- The existence of an emigration tradition with family networks in the receiving territories;
- Urban development causing a widening gap between cities and rural areas: economic gap, cultural gap, etc...;
- The potential of villages to retain its population; presence of infrastructure, local or nearby employment opportunities, etc...

For approximately 30% of network electrified households, electrification has helped curb emigration of household members. For approximately 62% of these households, electrification has no significant effect on emigration.

However, perceptions still differ depending on the status of electrification. We note in particular a clear difference depending on the mode of electrification. Network electrified households perceive a higher decrease in emigration as a result from electrification than PV electrified households (16%).

Chart 7. Perception of the effects of electrification on emigration: Has electrification encouraged emigration?

		encourages emigration			
		Rather yes	It didn't change anything	No, on the contrary	Total
		% line	% line	% line	% line
type of household	Electrified	8,3%	61,6%	30,1%	100,0%
	NE in V E	17,1%	46,1%	36,9%	100,0%
	NE in V NE	20,5%	35,6%	43,9%	100,0%
	NE in V PV	11,4%	59,1%	29,5%	100,0%
	PV in V PV	9,6%	74,0%	16,4%	100,0%
	Total	12,0%	55,6%	32,3%	100,0%

A multivariate statistical analysis allowed to clarifying the real effects of electrification on emigration in different social classes.

This analysis showed that electrification has various effects on household migration:

- For «rich» and «medium-income» farmers, already constituting few emigrants, it does not change anything.
- For small-income farmers / ranchers (high emigrant rates), as well as for farmers/ranchers with an income-generating domestic activity (low emigrant rates), electrification clearly reduces rural exodus. Emigration rate decreases by approx. 70%.
- For categories of farmers and craftsmen who own productive capital, electrification does not change anything. It was actually noted that this category is the one to benefit most from economic benefits of electrification: already constituting few emigrants, this category remains settled in douars.
- For the highest emigrant category whose income derives from emigration, electrification has a genuine slowdown effect (-33%) on the emigration rate, which remains the highest of all categories. However, this effect does not continue on the long run (after 10 years). This can be explained by emigration culture, motivated by the presence of strong family networks in the receiving areas.
- Finally, for the poor and very poor (farmers, farm workers and workers), electrification increases rural exodus (+ 200%) on a continuous basis. Two factors contribute to this phenomenon:

- 1) These poor, when electrified, reach a level of comfort (TV, lighting) not always compatible with their low and irregular income: this increased comfort is reflected by a significant increase in spending and thereby the needs of additional revenue that can only be obtained through emigration (see chapter on energy expenses);
- 2) television leads to – legitimate – ambitions to more modern consumption patterns (as shown by the surveys) that reinforce, for these poor classes, the motivation to seek additional revenue in the city.

The overall impact of electrification on emigration remains positive. The estimated reduction rate of emigration directly attributable to rural electrification is approximately 5%.

Achieving better results in this area is dependent on the introduction of structural measures which allow, in the long term, the creation of local employment pools for a sustainable settling of populations.

## 6.1. Return to the Village and Immigration

### 6.1.0. Return to the Villages

Electrification has allowed the return to the village of approximately 22% emigrants from network electrified households.

Chart 8. Perception of the effects of electrification on the return of emigrants from the family to the village

		Frequency	Percent	Valid percentage	Aggregate percentage
Valid	Rather yes	138	22,3	22,3	22,3
	It didn't change anything	344	55,7	55,7	78,0
	No, on the contrary	54	8,7	8,7	86,7
	I don't know	37	6,0	6,0	92,7
	No answer	45	7,3	7,3	100,0
	Total	618	100,0	100,0	

It may be estimated that electrification increases the return rate of emigrants by 1.5%. Thus, electrification helps maintaining the population in rural areas of Morocco.

### 6.1.1. Immigration

Immigration reflects the attractiveness of the village, mainly economically speaking.

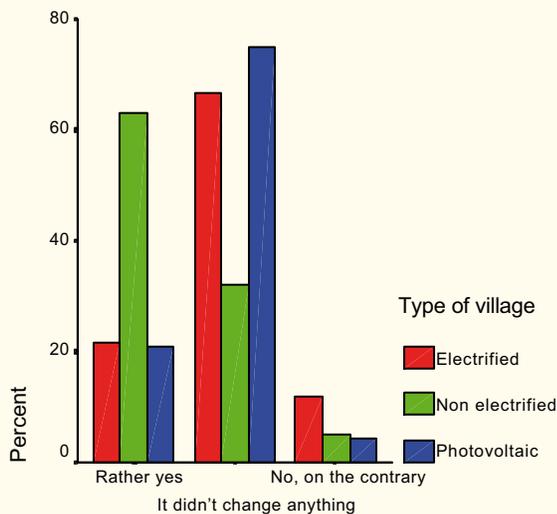
The village surveys address the immigration issue by asking the number of individuals non-originating in the village who settled this year and last year in the village. This should not be confused with the return of emigrants to the village.

Electrification is likely to attract immigrants if the area itself is a region of immigration.

In this vast movement, can electrification be a factor of increased appeal and allow immigrants - from neighbouring villages or rural areas - to settle in those areas?

In terms of perceptions by the villages, only 20% of (network + PV) electrified villages consider that electrification has allowed the return of emigrants to the village. 60% of the non-electrified villages believe that electrification would favour the return of emigrants.

Figure 6. Perception of the contribution of electrification to the return of emigrants



On the basis of the main trends emerged from the multivariate analysis of the different categories of villages, we can say that:

- In any case, in rich and medium agricultural villages, the attractiveness of the villages is improved by electrification. It can even be observed that in the category of lightly isolated villages and weak infrastructure, immigrants are less numerous in electrified villages (the immigration rate is 0.005) than in non-electrified villages (rate of immigration 0.015). This could be linked to the fact that the level of attractiveness of an electrified village decreases when the infrastructure fails to increase, with households preferring to immigrate in electrified villages with sound infrastructure.
- In the case of poor farmers, the attractiveness of the village increases with electrification when infrastructure is well developed. But the severity of this impact depends on the degree of isolation of villages:
  - In the case of heavily isolated villages, the immigration rate increases from approximately 0.002 in non-electrified villages to approximately 0.01 in electrified villages
  - In the case of lightly isolated villages, the effect of electrification is significantly higher, with an increase of the immigration rate from 0.007 in non-electrified villages to 0.03 in electrified villages. However, this effect does not apply in the long term.

## 6.2. Education and Schooling

To verify and assess the impact of electrification on the education of children, the survey is based on two approaches: the perception by villages and the extent of the average annual growth in the number of students in surveyed schools.

In terms of perceptions, electrified villages are divided regarding the impact of electrification on the education of boys: 47% think that electrification improves schooling, while 51% believe that this will not change anything.

We could observe the tendency to believe that schooling of girls increased by more than that of boys. Thus, 51% of electrified villages consider that schooling of girls has increased, as opposed to 47% who believe that schooling of boys has increased.

Regarding the second approach, statistical analysis could not lead to a conclusion about the impact of electrification on schooling.

From the processing of household surveys, about 82% of those electrified by the network felt that electrification has improved the schooling conditions of their children. This perception is a little less asserted among PV electrified households (70% of cases).

Furthermore, there is always this tendency to exaggerate the positive impact of electrification in non-electrified households, since about 90% of this category believes that electrification would improve children's schooling conditions.

**Chart 9. Did electrification improve your children's schooling conditions?**

Type of households	Improvement of schooling conditions			
	Rather yes	It didn't change anything	No, on the contrary	Total
	% line	% line	% line	% line
Electrified	82,4%	16,4%	1,1%	100,0%
NE in V E	91,9%	7,2%	,9%	100,0%
NE in V NE	92,7%	6,7%	,7%	100,0%
NE inV PV	88,4%	11,6%	,0%	100,0%
PV in V PV	70,1%	26,9%	3,0%	100,0%
Total	85,6%	13,3%	1,1%	100,0%

As regards the impact on the academic performance of children, most network or PV electrified households (79%) perceive an improvement in the academic performance of their children following the electrification.

**Chart 10. Did electrification improve your children's academic achievements?**

Type of households	Improvement of academic results			
	Rather yes	It didn't change anything	No, on the contrary	Total
	% line	% line	% line	% line
Electrified	79,3%	19,4%	1,3%	100,0%
NE in V E	93,1%	6,9%	,0%	100,0%
NE in V NE	93,3%	6,0%	,7%	100,0%
NE inV PV	89,1%	8,7%	2,2%	100,0%
PV in V PV	78,5%	18,5%	3,1%	100,0%
Total	84,9%	14,0%	1,1%	100,0%

## 6.2.0 Age of School Drop-Out

Multivariate statistical analysis showed that there was a need to distinguish two cases, depending on the level of access to school.

In the case of villages with schools, the positive impact of electrification on the dropout age of girls involves particularly the two extreme fringes of households:

- The poorest (workers, farmers, small farmers with domestic activities). For this fringe, the dropout age of girls is improved by an average of approximately 1.3 years;
- The richest (large landowners and small and medium-sized farmers / ranchers). The average increase in the dropout age of girls is 1.1 years.

The overall effect of electrification allows an increase in girls' average drop-out age of about 0.8 years.

In the case of villages that do not have schools, the effect of electrification is overwhelmed by the school inaccessibility factor. Thus, the impact of electrification on the girls' dropout age is marginal.

For boys, the dropout age does not seem to be affected by electrification regardless of the difficulty of access to school.

### 6.2.1 Schooling Rates

In the case of villages with a school, we can see a clear trend to a positive impact of electrification on the schooling of girls in most socio-professional categories:

- for «rich» and «middle-income» farmers, the effect of electrification on the schooling of girls is the most significant. Improvement rates of schooling vary, depending on the SPC from 16% to 75%;
- The impact of electrification on the schooling of girls is also significant in the poor farmers and workers category. The improvement rate of female schooling ranges from 15% to 30%.

In conclusion, we can say that electrification can only have an accelerating effect on the impact of other factors, such as access to educational infrastructure, and only a marginal effect on boys' schooling rates. Probably it has even a slight negative boys' deschooling impact among the poorest classes of farmers and workers. This phenomenon may be related to the destabilizing effect of television, in a context where the lack of education does not allow housewives to manage in an effective and profitable way both culture and consumption patterns brought about by television.

## 6.2.2 Children's Working Hours

It can be said that electrification generally has no visible effect in terms of extension of the children's time at school. A slight positive impact trend, however, is observed among the middle class and the poorer classes. In terms of changing work schedules, the introduction of electricity affects more the behaviour of children under the age of 10 than of adolescents. Children under 10 years from network or PV electrified households tend to prepare their homework at night through better availability of light.

In conclusion, we can say that the positive impact of rural electrification on children's education is conditioned by the availability of educational infrastructure in the village.

It is also important to note that the impact is clearly differentiated by gender. The positive effects are more significant on girls than on boys.

Finally, it also appears that the improvement in schooling indicators of girls has also benefited the poorest segments of society.

## 6.3. Health and Hygiene

The impact of electrification on hygiene and health is one of the most sought after. This impact was measured on the basis of global perceptions of villagers and dispensary officials, and of some indicators related to the operation of dispensaries.

Within the first category, around 2/3 of electrified villages consider that village electrification has had positive impacts on health, and 1/3 considers that it has not changed anything. The proportion is reversed regarding photovoltaic villages, suggesting that it is the lighting that improves health in the village through better security at night. The non-electrified considered by an overwhelming majority that electrification will improve health in the village. However, perceptions in electrified dispensaries are unanimous: electrification has brought a lot of benefits at several levels:

- Approximately 85% of the dispensaries estimate that the electrification allowed to use medical equipment for the care, and 75% consider it an opportunity to expand medical service in the evening,
- 80% believe that it has helped to reduce health problems in the villages, and 90% believe that it has improved the level of health.

Indicators from surveys on the operation of dispensaries clearly confirm the perception of the latter:

- 20 out of about 25 dispensaries surveyed are electrified,

- The rate of dispensaries with at least one refrigerator is 100% in electrified dispensaries (85%, however 15% continue to use a gas refrigerator), compared with 50% in non-electrified dispensaries,
- The conservation rate of vaccines is 95% in electrified dispensaries compared to 60% in non-electrified dispensaries,
- Regular stopping of a physician is provided in 85% of cases in electrified dispensaries, and only 40% in those that are not,
- No non-electrified dispensary assists in deliveries against 42% in electrified dispensaries.

#### **6.4. Drinking Water Supply (DWS)**

The immediate impact seen in the area of DWS and pumping is partial substitution of diesel by electricity. Thus, 68% of water pumping modes are electrical in 45% of the electrified villages with a DWS system. It was observed that only 20% of non-electrified villages have a DWS system and only 1 photovoltaic village is equipped with a DWS system.

Statistical analysis shows that the rate of villages equipped with DWS increases with the age of electrification (currently 30% of electrified villages have an electrified DWS system).

In some cases, electricity would have helped accelerate the installation of potable water supply systems. This impact is complex and depends on several factors including the size of the village, the agricultural situation in these villages and the degree of isolation.

#### **6.5. Women's Conditions**

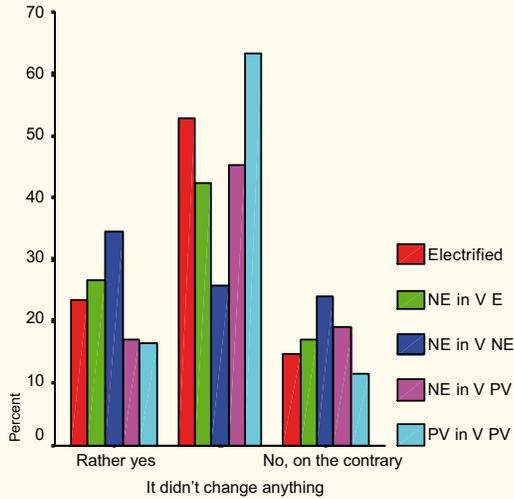
The impact of electrification on the living conditions of women were tackled under three themes: the perception of households with regard to the impact of electrification on the extension of working hours for women at home; firewood collection, and income-generating domestic activities carried out by women.

##### **6.5.0 Women's Working Hours**

Regarding the first topic, opinions are divided between those who believe that introduction of electricity induces an extension of working hours for women (25%) and those who think the contrary (20%).

Moreover, there is no significant difference of views among households with different electrification status.

Figure 7. Did electrification increase the working hours for women at home?



### 6.5.1 Wood Collection

Generally speaking, women are the ones who are collecting wood in most of the cases (almost 80% of cases). Multidimensional analysis according to socio-professional categories has shown that the impact of electrification on the collection of wood depends on the type of household category: electrification eases women's burden of wood collection in wealthy and middle classes, but increases the burden of the poor.

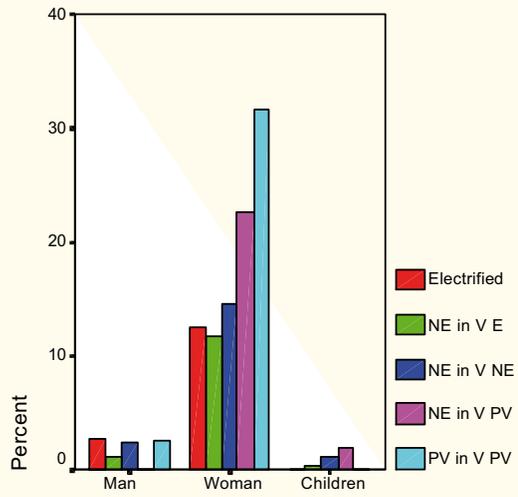
In conclusion, the impact of electrification on wood collection by women remains positive on a global level, but moderate in the light of opposite trends observed.

### 6.5.2 Women contribution to income-generating activities

It is generally recognized that rural electrification has an impact on the participation of women in income-generating domestic activities. Two types of trends have emerged:

- in urban oriented villages electrification induces an increase in the participation of women of poor SPC domestic activities in income-generating activities;
- In more rural oriented villages there is no effect of PV electrification on this indicator in all SPC.

Figure 8. Who works in income-generating domestic activities?





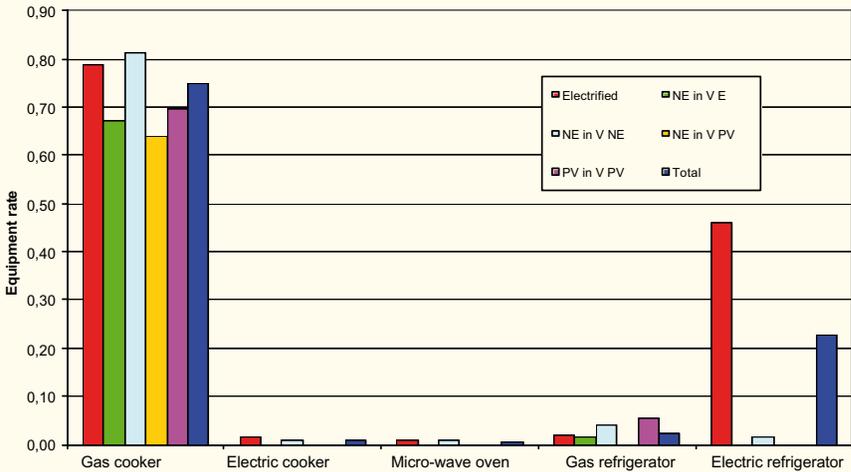
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## 7.0.1. Electric Household Appliances

Around 47% of electrified households own an electrical refrigerator, while the rate was virtually zero before electrification. Regarding the household equipment rate in gas cookers, which is approximately 75%, statistics do not show significant differences between electrified households and non-electrified households. Other equipment such as microwave oven and electric cookers are virtually non-existent.

Figure 10. Equipment rates of households with electric kitchen appliances, by electrification situation



## 7.0.2. Small Electric Appliances

Figure 11. Rate of distribution for a typical household

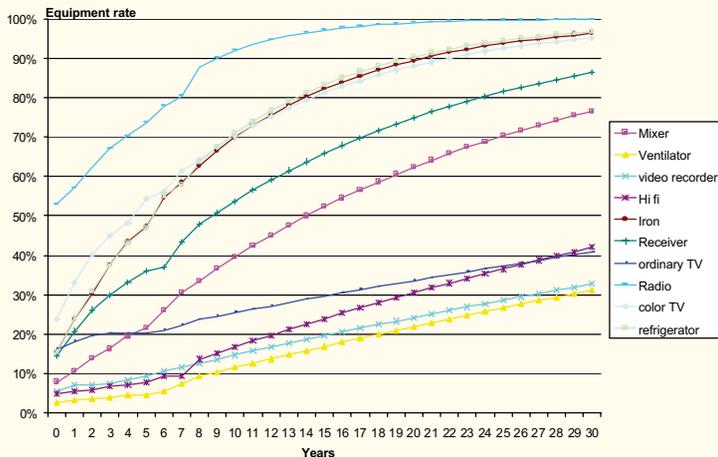
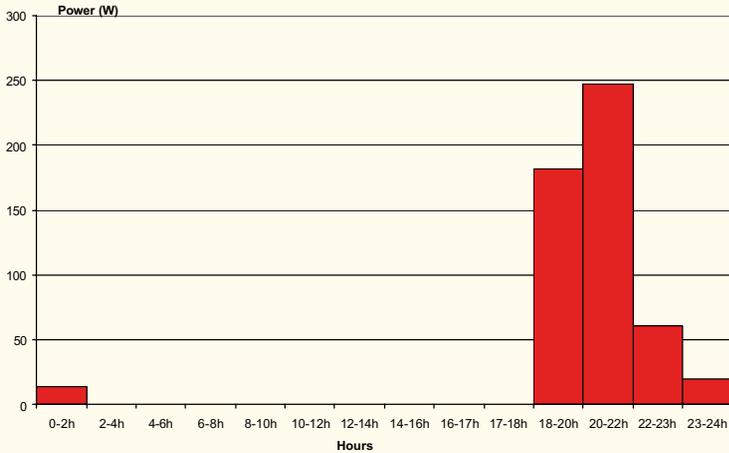
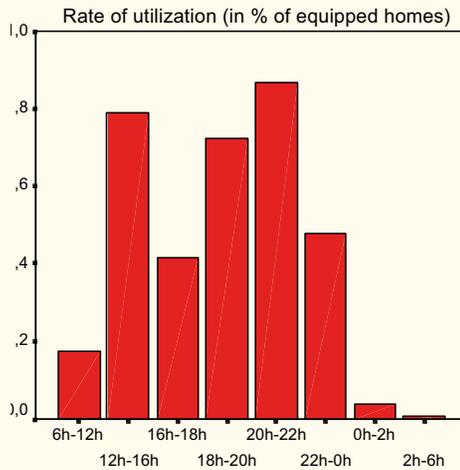


Figure 12. Load average for lighting



Consumption of lighting is estimated in average to 1070 Wh/day.

Figure 13. Load for television

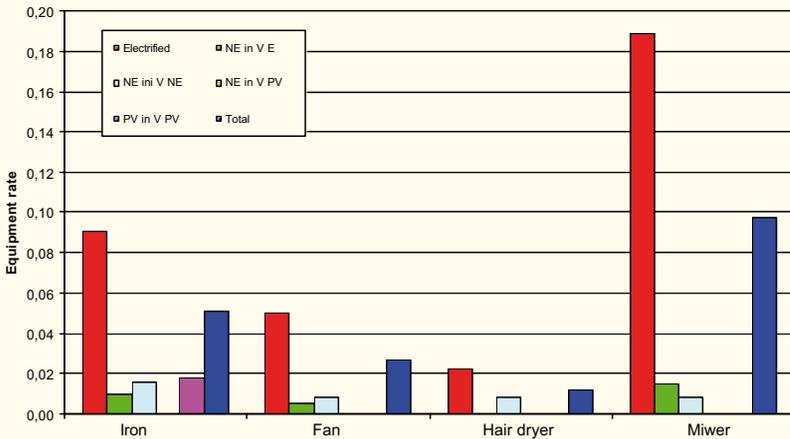


We record two peaks, one during afternoons and concern globally women and the other one during evenings and concern more men and the whole family. In total, the average duration of TV utilization is of about 6415 mn per day.

### 7.0.3. Small Electric Appliances

Small electric appliances are used primarily in network electrified households. Apart from mixers (robot), with a penetration rate around 19%, other appliances have relatively low rates. The iron is progressing very quickly and in the same way as the refrigerator, increasing from 5% of households before electrification to 24% one year later, 47% after five years, and over 70% after 10 years. 5% of households own an electric fan with less than 1% before electrification.

Figure 14. Household equipment rates with small electric appliances by electrification situation



### 7.1. Eating Habits

Approximately 45% of electrified households reported perceiving a change in their eating pattern generated by electrification. This rate is significantly lower than that observed among non-electrified households in non-electrified villages (65%). These changes relate to the increased consumption of fresh produce, by the introduction of cold and the possible increase in the consumption of canned food, due to the impact of television advertising.

Monivariate and multivariate statistical analysis found that there were no significant differences between the different categories of households depending on the situation of electrification, as regards the consumption frequency of these products. However, we can say that the preservation quality of fresh produce has certainly improved.

Figure 15. “Did electrification change your eating habits?”

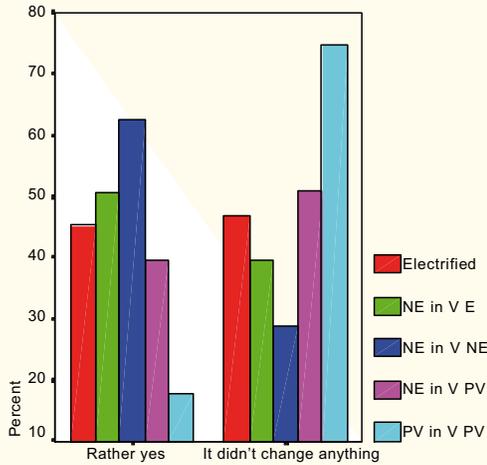
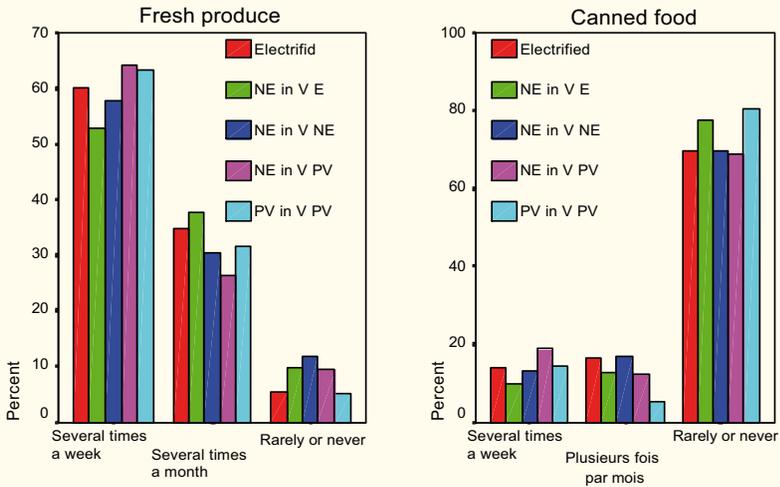


Figure 16. Consumption of fresh produce and canned food by electrification situation



## 7.2. Rhythm of Life

In general, a huge gap was observed between the perceptions of electrified villages and the expectations of those not yet electrified.

The survey shows that 60% of electrified households say that electrification induced changes in their sleeping patterns.

Those who saw the least change in sleeping rhythms are PV electrified households. This can be attributed to the constraint of limited service offered by PV kits.

A thorough statistical analysis shows that there was a significant gap between network electrified households and other households with regard to men's, women's and adolescents' slumbering times. In network electrified households, approximately 50% of men and women go to bed between 22h and midnight (40% among teens), while the rate is not higher than 30% among other categories of households.

Finally, PV kit electrified households are not affected by the introduction of electricity. We do not note any significant differences compared to non-electrified households with regard to the slumbering and waking time, for all categories of individuals (men, women, teenagers, and children).

The categories of predominantly agricultural households are least affected by the impact of electrification on the schedule for bedtime. This is true for all categories of individuals (men, women, adolescents, and children).

Likewise, there was a very slight difference between network electrified households and other households, with respect to the awakening time of men and women, who tend to wake up later. This difference relates less to children and adolescents.

### **7.3. Life in the Village and Safety**

The analysis of collected data clearly shows that electrification brings more animation into the village. It is primarily related to the existence of functional street lighting, which allows people to continue their daytime activities at night, to gather more often in the village in the evening and possibly to bring sound to feasts and other events. This animation is also due to the fact that people stay up longer.

Finally, electrification (through public lighting) clearly decreases the danger associated with having to move around in the dark. Other forms of insecurity do not appear to be reduced by electrification which explains why there are different views.





**IMPACTS ON  
HABITAT**

## 8.0. Transformation of the Type of Construction

There has been a real impact of electrification on the rate of permanent constructions (expressed as a % of the total number of units). Aggregate households increased within 5 years from 39% to an average 46% of masonry constructed rooms (and within 10 years from 38% to 53%), accounting for an average increase of 8% over 5 years and 15% over 10 years.

This impact is visible in nearly all categories of households. In the category of big farmers, the rate of masonry constructed rooms has increased from 80% to 100% over 5 years, in the category of small and medium-income farmers and ranchers, it has doubled over 10 years since it increased from less than 30% to nearly 60%. There is a significant increase (from 10% to 40% of masonry constructed rooms over 10 years) in the category of farmers/ranchers with income-generating domestic activities, while the rates increased from 23% to 63% in the category of literate employees (usually lower officers).

In the category of farmers and craftsmen owning mechanical assets, the rate increased from 42% to 57% over 10 years and from 30% to nearly 80% in the category of households with main income from emigration.

It was also observed that electrification participates indirectly in the urbanization of villages.

### 8.1. Adding Specific Rooms

Of the 17% of households who added rooms after electrification, the real share due to electrification is probably in the range of 8 to 12% additional households, knowing that the average number of rooms per household increases by about 0.5 after 10 years to reach 6 rooms in total.

The categories of affected households are farmers-ranchers with income-generating domestic activity, for whom the growth of the number of rooms is rapid (over 2 to 3 years) from an average 6 to nearly 10, i.e. nearly 4 additional rooms, out of which 2 to 3 are constructed in masonry, and «literate employees» for whom the increase in the number of masonry constructed rooms from 1.5 to almost 4 is continuous over 5 years, which implies the renovation of the house and / or the building of new homes.

This rate turns around (+1.5), i.e. (+2 masonry constructed rooms over approximately 10 years) in the farmers / mechanized craftsmen category, as they give more priority to the acquisition of productive capital rather than improvements, and (+0.5 total rooms, and +1.5 to 2 masonry built rooms) in the category with main income from emigration.

### **8.1.0. Separate Room for the Kitchen**

Owning a separate kitchen is essentially a cultural and local aspect that is almost unaffected by electrification. Only 1% of households have built a kitchen following electrification.

The categories of households likely to add a kitchen because of the electrification of their habitat are «literate employees» (+20%), farmers / craftsmen owning productive assets (+10 to 15%), and in a lesser extent «households with main income from emigration» (+5 to 10%).

#### **8.1.1. Other Utilities**

Electrification has only a marginal effect on the construction of toilets since only 1.6% of households have built toilets after the electrification of their homes. The impact of electrification is a maximum of 1.6%. However, electrification accelerates the fitting out of living rooms in households. The acceleration is not immediate, but appears after some 5 years of electrification, with a surplus of 3.6 to 5.2% of households fitting out a living room.

In the long term (10 years), this surplus remains persistent.





**IMPACTS ON  
THE  
ENVIRONMENT**

## 9.0. Impacts on the Landscape

Surveys show that all villages are indifferent to «visual pollution» that could go along with network electrification. However, the network may, in some cases, objectively disfigure the landscape in a village. The stakes are high, particularly in the case of villages where the landscape is a strong tourist attraction asset. At least, for this type of village, ONE could take steps to mitigate the negative impact on the landscape (burying cables, poles design, etc..).

### 9.1. Land Price

Almost 60% of network electrified villages felt that the price of building land has not changed. By contrast, 36% believe that the price has risen (a lot: 23%, slightly: 13%).

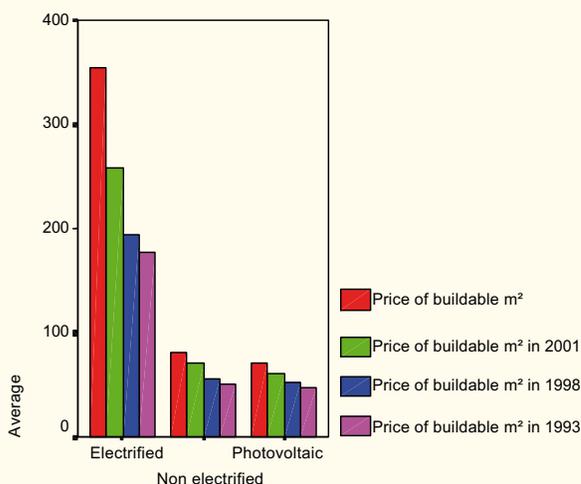
Perceptions in PV villages are very different. Around 90% of villages do not perceive a change in the price of building land.

That difference reinforces the argument that the power grid acts as structural equipment.

The prices of land are unevenly distributed, and on average significantly higher in electrified villages than in non-electrified villages. In 10 years (1993-2003), the price of building land has increased by 100% in network electrified villages, 50% in non-electrified villages and 40% in PV villages.

However, statistical analysis showed that this trend was largely due to two key factors: isolation and the size of the village.

Figure 17. Change in prices of building land, by types of villages (Dh/m<sup>2</sup>)



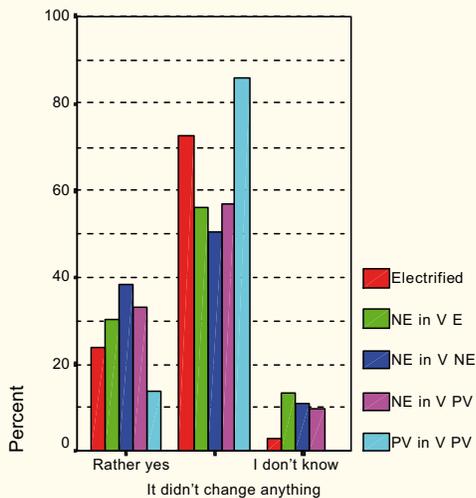
Village isolation undeniably affects the price of building land. Therefore, the higher the size of the village, the greater the cost of building land is important. Multivariate statistical analysis has demonstrated that network electrification induces higher prices of land, and that the impact of electrification on the price of building land is nil in highly isolated villages and gradually grows as isolation decreases and the size of the village increases.

In conclusion, we can say that the price trend was largely due to the phenomena of slow urbanization and that electrification plays a modest but genuine role in the acceleration of price increases in certain local contexts.

## 9.2. Wood Collection

Only 23% of network electrified households consider that their firewood consumption has decreased, as opposed to more than 70% who believe it has not changed. Perceptions of photovoltaic electrified households are even more striking, as 86% believe that it hasn't changed anything, whereas only 12% consider that their consumption has rather decreased.

Figure 18. Perceptions of households related to the influence of electrification on the reduction of firewood consumption, by types of households



## **9.3. Discharge of Batteries**

### **9.3.0. Rate of Recovered Batteries**

The rate of batteries taken away by a garbage-collector improved from 12% among non-electrified households to 24% among PV electrified households. There is a genuine impact in terms of acid discharges and various pollutions (lead). It should be mentioned that within the framework of the «photovoltaic electrification» of the PERG, private partners involved in maintenance operations of photovoltaic kits have a responsibility to «recover and recycle batteries,» and will prevent any adverse impact of the batteries of their systems discharged on the spot and thus achieve a 100% elimination rate.

### **9.3.1. Batteries Spared by Electrification**

Approximately 47% of non-electrified households have a battery (without a solar panel), and 12.8% have a PV system, i.e. a total of 58.6% who have a battery (with or without panel).

As a direct consequence of network electrification, batteries and associated discharges are therefore eliminated. For an average household, given its likelihood of electrification, 0.45 batteries per electrified household are thus eliminated through network electrification.

Finally, the electrification network prevents the pollution of 0.4 batteries / electrified household, knowing that 0.05 batteries / electrified household will be taken away by a garbage collector.

The impact in terms of pollution is significant; for 100 000 households, 40 000 batteries will no longer be locally discharged, i.e. 80 000 litres of acid (average) will be prevented from polluting the soil. Again, for 100 000 households, the amount of avoided acid pollution over 10 years (taking an average battery life of 2 years) is 400 000 litres.



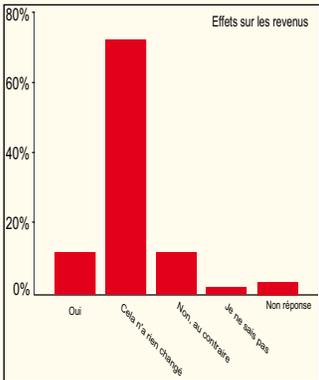
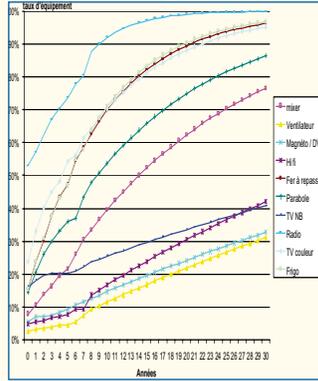
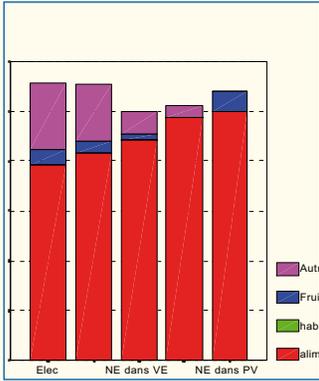
**ENHANCEMENT  
OF THE  
IMPACTS:  
TOWARDS AN  
INTEGRATED  
APPROACH**

It appears that improved access and investment viability in rural areas can only be achieved through electrification. The effort needs to be shared by other sectors in the field of basic infrastructure, health, agriculture, handicrafts and local industry.

Before concluding this report, it should be mentioned that in order to make these impacts more effective, associated measures must be put in place with the aim of establishing an integrated development that could affect roads, health and dispensaries, drinking water supply, agriculture and irrigation areas, as well as crafts and local industry. Other partnerships will favour the acceleration of economic development in electrified zones and subscription rates by reducing financial barriers related to a lack of household savings. They include partnerships to be entered into with financial institutions to facilitate the financing of credits for electrical installation or production equipment, as well as initial participations in electrification operations.

Following these conclusions, the ONE launches the Rural Electrification Development Plan (VED Plan) based on an evaluation study of the PERG, including its strengths and weaknesses. It will constitute a mechanism to capitalise the lessons learnt from the PERG regarding investment and infrastructure aspects, financial and economic aspects, and aspects relating to socio-economic impacts.

This assessment study should lead to a White Paper which will set the contours of the VER Plan policy. According to the CEO of the ONE, this policy will be built upon three approaches, the first of which being the valuation of assets of the PERG by promoting the association of economic activities induced by electrification. The second approach deals with the development of outreach services, partnerships with funding agencies and the associative sector. The third approach will be dedicated to the enhancement of experiences by sharing them, in particular, within the framework of South-South cooperation.



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