Intelligent Energy Europe

COOPENER

Contract no. EIE/04/201/s07.43094

DEA

Development and Energy in Africa

Intelligent Energy – Europe (IEE)

Type of action: COOPENER

Key action: VKA11.1

Synthesis Report on Case Studies of 6 African Countries

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February 2007

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Title: Synthesis Report on Case Studies of 6 African Countries

Abstract
The 30-month COPENER project is implemented by Risoe National Laboratory, Denmark as project coordinator, in collaboration with the Energy Centre of the Netherlands (ECN), and in partnership with six African Centres:

- Botswana: EECG
- Ghana: KITE
- Mali: Mali Folkecenter (MFC)
- Senegal: ENDA-Energy
- Tanzania: TaTEDO
- Zambia: CEEEZ

The overall objectives of the project are:

- that national energy policy is better informed to take into account the complex linkages between energy interventions and social and economic development, and
- that energy interventions are better designed to contribute to real development needs, especially poverty alleviation and income generation, and otherwise achieving the Millennium Development Goals.

The immediate objectives of DEA are:

- to establish and apply an Assessment Framework for evaluating development and poverty impacts of energy interventions, and
- to engage in a dialogue with energy policy makers and other stakeholders on the basis of the framework, with a view to incorporating these issues in energy policy.

This synthesis report brings together the results of case studies (WP6) undertaken in the six participating countries of Botswana, Ghana, Mali, Senegal, Tanzania and Zambia, the purpose of which was to test the methodological performance of the Preliminary Assessment Framework (WP5). The result of WP6 will then inform the refinement of the Assessment Framework, which is the main product (WP7) of the DEA project.

February 2007

Contract no.:
EIE/04/201/S07.43094

Sponsorship:
European Commission
Intelligent Energy Europe
COOPENER Programme

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Abbreviations and Acronyms

AFREPREN	- African Energy Policy Research Network
AF	- Assessment Framework
BPC	- Botswana Power Corporation
CBBP	- Cross Border Biodiversity Project
CD	- Compact Disk
CHESCO	- Chipata Energy Service Company
CO_2	- carbon dioxide
DANIDA	- Danish International Development Assistance
DEA	- Development and Energy in Africa
DSRESDL	- Developing Sustainable Rural Energy Strategies at District Level
ECN	- Energy Centre of Netherlands
EAD	- Energy Affairs Division
EC	- Energy Commission (Ghana)
ECG	- Electricity Company of Ghana
EECG	- Energy, Environment, Computer and Geophysical Applications
ESCO	- Energy Service Company
EU/EC	- European Union- European Commission
GDP	- Gross Domestic Product
GEF	- Global Environmental Facility
GVEP	- Global Village Energy Partnership
H/H	- Households
HIV/AIDS	- Acquired Immune Deficiency Syndrome
IAD	- Institutional Analysis and Development
ICS	- Improved Cook Stove
ICT	- Information and Communication Technologies
kWh	- kilowatt hour
LFA	- Logical Framework Approach
LPG	- Liquid Petroleum Gas
MDG	- Millennium Development Goals
M & E	- Monitoring and Evaluation
M&EED	- Monitoring and Evaluation for Energy and Development (GVEP-facilitated international working group)
MTG	- Multisectoral Task Group
NDP	- national Development Plan
NEMC	- National Environment Management Council- Tanzania
NES	- National Electrification Scheme- Ghana
NESCO	- Nyimba Energy Service Company
NSGRP	- The national Strategy for Growth and Poverty Reduction
PAF	- Preliminary Assessment Framework
PV	- Photovoltaic
RCS	- Rural Electrification Collective Scheme
REGE	- Rural Electrification by Grid Electrification
REFAD	- Renewable Energy for African Development
SD	- Sustainable Development
SME	- Small and Medium Enterprises
SMME	- Small, Medium and Micro-Enterprises
TATEDO	- Tanzania Traditional Energy Development and Environment Organization
TV	- Television

UNDP	- United Nations Development Programme
UNEP	- United Nations Environment Programme
URC	- UNEP Risoe Centre
US$	- United States Dollar
VCR	- Video Camera Recorder
VDC	- Village Development Committee
VEC	- Village Environment Committee
VRA	- Volta River Authority
WP	- Work Package
WRE	- Women Renewable Energy (project of Mali)
ZESCO	- Zambia Electricity Supply Commission

Scope of the DEA project

Development and Energy in Africa (DEA) is a project under the European Commission's Intelligent Energy - Europe programme COOPENER. Ultimately DEA aims to "support decision makers with the implementation of more sustainable energy policies, …" in line with the key action VKA 11.1 of the COOPENER programme. The project will do this by identifying and quantifying, where possible, the elements of concrete energy interventions that contribute to sustainable development (SD) and systemising this in an Assessment Framework, which can enhance policy to promote energy for sustainable development.

The principal aims of the Development and Energy in Africa (DEA) project are (i) to identify and examine the developmental impacts of energy innovations and actions linked to improving energy access and poverty alleviation and (ii) to use the information obtained to improve on-going and future energy interventions through the energy policy makers and institutions in the countries concerned.

The project is organised in nine Work Packages:

WP1: Project Management: To accomplish efficient management and implementation of the project in a timely and efficient manner, including liaison with Advisory Committee as required.

WP2: Literature Review, aimed at establishing an overview of available methods for analysing development, poverty and energy linkages and of results in this area.

WP3: Compilation of a Catalogue of Energy Interventions in the target countries, including as far as possible economic, social, environmental impacts, noting inter-sectoral linkages.

WP4: Consultation with national policy makers and stakeholders regarding the relationships between energy innovations and sustainable development, aimed at achieving consensus on the needs for the Assessment Framework and on how it can contribute to the energy and development process. Although the main objective is to obtain information for input to WP5, the consultation process will continue throughout the project to keep policy makers and stakeholders informed and to ensure that the project is in line with national needs. WP4 includes a set of National Workshops early in the project period to involve stakeholders in the process. This involvement is backed up by informal contacts and consultation, primarily by the African Centres.

WP5: Development of a Preliminary Assessment Framework (PAF) for assessing development and poverty impacts of energy interventions, including developing indicators for assessing energy-poverty/development links

WP6: Case Studies to test the PAF. Results will be discussed in National Workshops #2 and stakeholder views incorporated.

WP7: Analyse Case Studies and Refine Methodology to a final Assessment Framework (AF).

WP8: Dissemination: Communicate project results to national policy makers and stakeholders and discuss how the Assessment Framework can contribute to policy and strategy formation, both in the target countries, elsewhere in the region and at regional level. WP8 includes a set of National Workshops #3 (to communicate the Assessment Framework to the national target group) and a Regional (African) Workshop towards the end of the project. In the latter event all country teams and selected key stakeholders will meet to discuss the outcome of the project, with the possibility of other regional and international participants as the budget and circumstances allow.

WP9: Common Dissemination Activities: to provide resource and budget provisions for common dissemination activities in the framework of the EIE programme.

This synthesis report brings together the results of case studies (WP6) undertaken in the six participating countries of Botswana, Ghana, Mali, Senegal, Tanzania and Zambia, the purpose of which was to test the methodological performance of the Preliminary Assessment Framework (WP5). The result of WP6 will then inform the refinement of the Assessment Framework, which is the main product (WP7) of the DEA project.

1 Background

1.1 The DEA Project and Case Studies

In the context of the EU COOPENER project Development and Energy in Africa (DEA), (www.dea.deafrica) six case studies on energy interventions have been carried out by African Centres[1] in six Sub-Saharan countries: Botswana, Ghana, Mali, Senegal, Tanzania and Zambia. In addition, and in parallel, a case study was carried out in Tanzania towards the dissertation of the MSc degree by Ms. Mairi Dorward, University of Oxford, and with support and involvement from the Tanzanian Centre TaTEDO.

The seven case studies examined the inputs, outputs, outcomes and developmental impacts of a variety of energy interventions, which had been implemented in the six countries. The case studies applied a methodology or "Assessment Framework" (AF) developed in collaboration between UNEP Risø Centre (URC), ECN (Netherlands), the six African Centres and the international Monitoring and Evaluation for Energy and Development (M&EED) group facilitated by GVEP.

The purpose of the case studies was to test the suitability of the "Assessment Framework" for identifying and evaluating outcomes and impacts of existing small- to medium-scale energy projects. Moreover, the methodology, involving a 4-level structure with associated indicators, can also be used for monitoring and evaluation of ongoing energy projects, as described in a manual of the M&EED group (www.dea.deafrica).

The case studies were planned by the six African case study teams, facilitated by Risø and ECN staff, at a workshop in June 2007, at Fringilla, Zambia. (The study by Mairi Dorward was planned in parallel, in consultation with dissertation supervisors Phil Mann and Gordon Mackenzie, as well as the host Centre TaTEDO.) Hence, the process of preparing the case study was termed, 'The Fringilla Process'. The Fringilla Process is taken to mean the process from delimiting the system boundary of the intervention to be studied, constructing the 4- (or more) level causal chain or diagram, translating the causal diagram into assessment tables (fiches) including data to measured, associated indicators, information sources and methods, and culminating in a research plan.

1.2 The Need for an Assessment Framework

There is broad consensus that access to adequate and affordable (modern) energy services is essential for input to economic, social, and environmental dimensions of human development. There is prolific documentation that has been produced that has correlated the use of modern energy services with standard of living indices such as poverty levels, mortality rates, literacy levels and lately, energy's contribution to achieving the Millennium Development Goals is widely recognized.

What the challenge has been is the attribution of development impacts to energy interventions[2]. The need therefore exists to assess the impacts of providing energy services on development, particularly poverty reduction that has become the focus of many development practitioners. It is within this context that the current project "Development and Energy in Africa (DEA)" was initiated in order to identify and analyse the existing relations between Development and Energy. The main outcome of the DEA project is an assessment framework (AF) that can link the impacts of energy interventions on development. The AF

[1] The six African Centres comprise: EECG Consultants (Botswana), KITE (Ghana), Mali Folkecenter (Mali), ENDA (Senegal), TaTEDO (Tanzania) and CEEEZ (Zambia).

[2] These are projects/programmes, policy or innovation-either technological or institutional that affects energy demand and/or supply in a country

itself is a step-by-step approach to evaluating such impacts of energy interventions on development. The construction of the Preliminary Assessment Framework (PAF) has benefited from literature reviews (WP1), stakeholder consultations and workshops (WP3), the analysis of a number of energy interventions that have been implemented in the participating countries (WP3) and similar initiatives being undertaken by other energy-development practitioners particularly the work of the M&EED under GVEP. Fig 1.1 provides the linkages among the DEA project work packages and how they are connected in developing the Assessment framework.

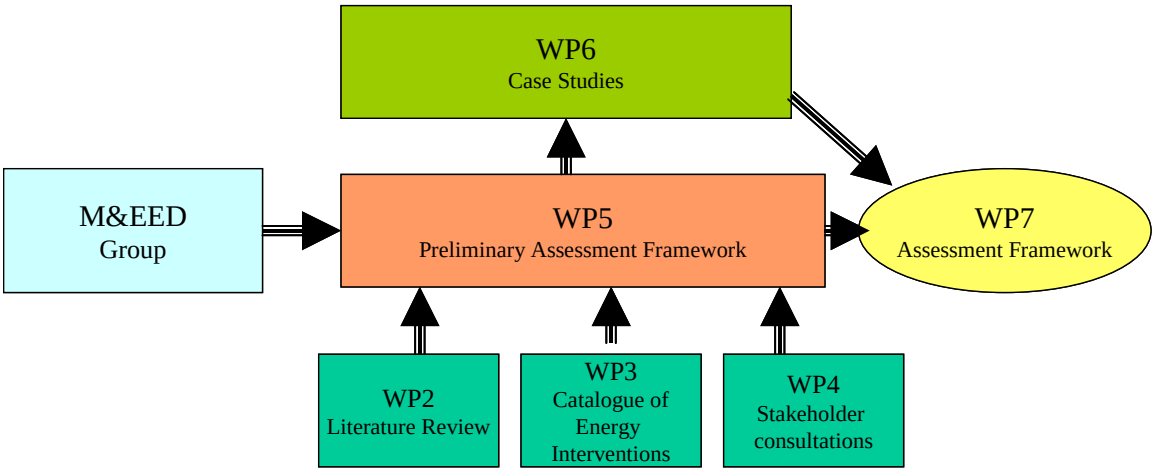


Fig 1.1 Inter-linkages of Work Packages with the Assessment Framework and other initiatives.

The elaboration of this Assessment Framework (AF) is being developed in a bottom up –approach (Fig 1.1) the detailed case studies have been selected to test the Preliminary AF's performance as a tool for verifying the hypothesized development impacts of selected energy interventions.

2 The Assessment Framework

The development of the Assessment framework has borrowed from the work of M&EED and has some features that resemble the Logical Framework.

2.1 MEED Guidelines

MEED under GVEP has developed some guidelines on monitoring and evaluation of projects particularly for projects that were designed without an M & E plan. The approach has adopted Development Aid Committee of the OECD terminology in defining the causal chain from the project inputs to outputs, to outcomes and then impacts on development. The same terminology has been adopted in the development of the Assessment Framework. Other terminology can be adopted in developing an impact analysis of projects as is the case for the Logical Framework Approach (Section 2.2 below). The outcomes and impacts adopted in the M &EED and AF approach could be compared to the immediate objectives/purpose and the development objective respectively in the Logical Framework Approach.

The M&EED as stipulated in the Guide for Monitoring and Evaluation for Energy Projects (V 10) tries to demonstrate a plan for measuring the success, or Monitoring and Evaluation (M&E) of energy projects' contributions to socio-economic and environmental development. The M&E is intended to measure the progress and success of the project according to agreed **indicators** that can be both quantitative and qualitative values, describe reality and indicate degree of change. Ideally, these indicators can be measured at the beginning of the project; during the project; at the end of the project, and perhaps several years later. Documenting conditions at the beginning of the project is important because it provides a picture of the status quo or a **baseline** from which to measure progress or changes.

While the need for M&E is general to all projects, the specific tools - indicators, data collection procedures, analytical methods, can vary according to the specific local conditions and to the needs of stakeholders. Project teams developing M&E schemes for energy projects therefore face some specific challenges and difficulties, as compared to other types of projects, for instance water, agriculture, health or education projects because: energy does not directly, feed, house, or clothe people. Rather, energy services are necessary in the production of food, clothing, health services, etc. As a result, the **causal chain** leading from energy to an improvement in people's lives is often longer and more complex than for projects directly executed in the development sectors. Energy services often bring improvements in several areas. For instance electricity can be used to pump water, to refrigerate vaccines, to weld metals, etc, thus, M&E for energy projects also faces the challenge of **measuring improvements in more than one area**.

The positive impacts of access to energy often may become manifest many years after the project ends. Thus, reliable M&E for energy projects must often **extend in time** even beyond the project life cycle. The positive effects of energy often require many other inputs. For instance energy can contribute to revenue generating activities. But for these activities to be created, appropriate raw materials, markets, skills, transportation, etc. must also be available, or made available by other development activities. Therefore, M&E in energy projects must propose a scheme to **attribute the improvements** to the different factors that were present, in order to identify the specific impact of energy. Ideally the wish is to measure the impact of energy on development, in a language that can be understood in the context of development imperatives and the Millennium Development Goals (MDG).

In practice however this is very difficult and there are a number of complexities that need to be addressed for instance, there are no recognized standards of what to measure and how to measure. Changes in MDGs cannot be attributed to single factor, as there other factors at play e.g. macro-economics, political, wars, epidemics, climatic cycles; other infrastructure programmes and individual project design and uses of energy. Establishing the baseline itself is also complex and it is not being done pre-project in practice.

The M&EED Guide proposes an approach to at least partially overcome the difficulty, by:

- Understanding what the project is made of and why, what is its history, how were the decisions made; focusing on what is easily observable;
- Making some interpretations in terms of impacts on development, based on consensus;
- Establishing an interpretation of the observables by the use of proxies and "reference studies".

Given these specificities, developing M&E for an energy project can be very challenging. The M&EED Guide proposes some ideas and methods to aid energy project teams in meeting this challenge. It provides a 10-step process that project teams may follow to define a project specific M&E scheme and make detailed suggestions on how this method can be applied to concrete projects in Decentralized Rural Electrification, Rural Electrification by Grid Extension, Regularization of Urban Electrification, Improved Biomass Stoves and Institutional Support. The 10 steps are:

1. Identify your project stakeholders' M&E needs
2. Make a diagram of your project
3. Assign project results to the links in your causal chain
4. Choose indicators and data collection methods
5. Address transversal issues
6. Write up a draft M&E scheme
7. Validate your scheme with your M&E stakeholders
8. Integrate stakeholder comments into M&E design
9. Execute M&E as part of the project
10. Conclusion, present the results of M&E

Regardless of the Guide, there are still many complex issues involved in energy project Monitoring and Evaluation that are not covered.

2.2 The Logical Framework Approach

The logical framework approach (LFA) is extensively used in project design and is a tool among several others that can be used for project planning. It is also intended to define the project design based on meeting all interested and affected parties (stakeholders) and the project LF is developed by the group of stakeholders who will ensure that their interests are included in the project design. The LFA presupposes that project objectives can be achieved if certain preconditions and assumptions hold true during the implementation of the project (Table 2.1). After the LF is done, the tendency has been to evaluate the project performance just against the predefined indicators. Similar to the AF, attributing impacts and indicators to the objectives is a constraint to using the LFA. Often the actual impact to development

objectives is assumed rather than measured, as the impact location and time of onset may never be evaluated after the project is complete. This is true of donor-funded projects that often end when the immediate outputs are accomplished. There is often no provision to verify if development impacts have occurred.

Table 2.1 Data tables for the Logical Framework Approach

	Indicators	Means of Verification	Assumptions (external factors)
Development Objective			
Immediate Objective			
Outputs			
Activities	Inputs		

2.3 Assessment Framework

The several tools or methods that are used for the evaluation of impacts depend on the type of evaluation, the type of intervention, the availability of data, and the nature of the people to which the tool is to be addressed. The main challenge of the DEA project was therefore to develop an evaluation guide or Assessment framework that could be adapted and used for the evaluation of different types of energy projects. Therefore the tools and methods used within the framework of the DEA project have combined aspects of M&EED procedures (the Results Models), Sustainable Livelihoods Approach Methods (SLA) and the Millennium Development Goals (MDGs).

The AF has mainly been developed around the M&EED procedures basing on the same four -level: input – output - outcomes – impacts Results Model as illustrated in Figure 2.1 below.

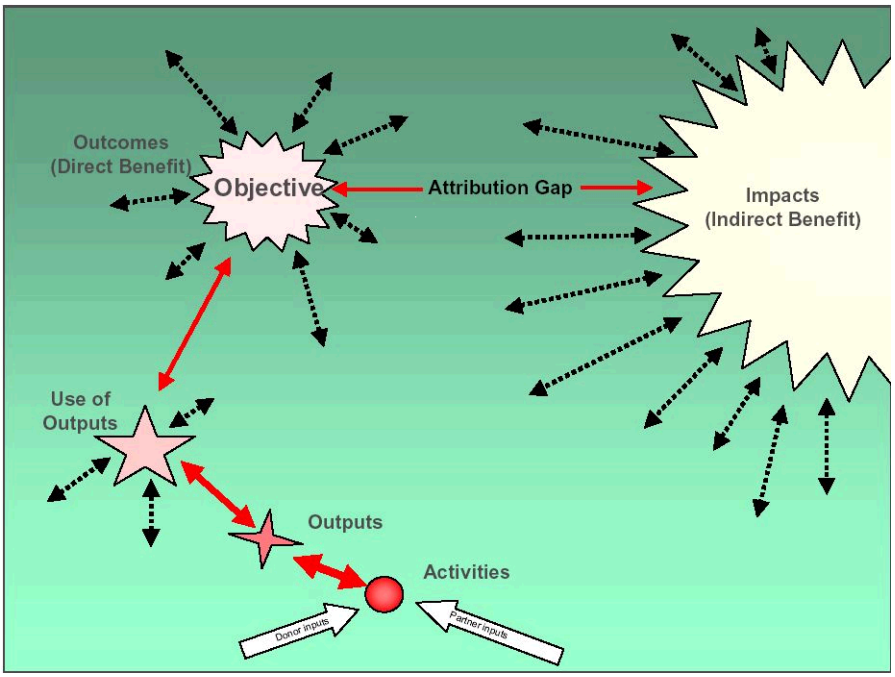


Figure2.1 Results Model (Causal chain linking the project's activities to the impacts)

The Results Model is a chain of cause-and-effect linking the services or output the intervention is supposed to accomplish. It shows how this combination is supposed to work and which activities are needed to accomplish the expected outcome and hence realize a development impact.

The links of Results Model are described as:

- The activity of the project brings in the target area some resources (equipment, finance, or institutional assistance) that are supposed to generate some output. The first link of the method is therefore to identify the outputs generated by the project. These are often the direct result of activities e.g. connections of consumers to the grid, produced biomass stoves etc.
- The second link establishes the relations between the outputs of the project activities and the energy services provided in each sector, which are the use of outputs.
- The third link relates the energy services and changes resulting from these services. These are the outcomes.
- The forth link is the most problematic. It endeavours to establish a relation between the outcomes and their effects in the long term, which are the impacts.

The Sustainable Livelihoods Approach Methodology provides the tools for the selection of the indicators, and the collection of data. It provides the tools for stakeholders' analysis and there is ample literature that discusses sustainable livelihoods (www.undp.org/sl)

The Millennium Development Goals, and the development objectives of the countries becomes the reference framework to evaluate the impacts.

There are two important components to the AF. One is hypothesizing the impacts of energy interventions on development at planning stage similar to the LFA. The other is to verify the energy impacts by collecting relevant data that can be translated into development indicators (for outputs, outcomes, impacts).

Hypothesizing the impacts of energy interventions on development in the AF starts with a conceptual framework that is presented as Causal Chain diagram, where aspects of energy inputs, outputs, outcomes and impacts are directly and cross-linked. The Causal chain can be elaborated within the four-level to include energy services between outputs and outcomes and also relating the value chain to actual development sectors. This is considered important in order to relate impact analysis results to specific stakeholders in the development sectors. The link between outcomes and impacts can also be further elaborated to reach a point where conclusion on the development impact e.g. as referenced to MDGs is easier to reach.

The AF, through the causal chain is thus a flexible tool that can be modified and elaborated as required to meet the assessment level required for the different energy interventions.

When the Causal Chain has been elaborated to the satisfaction of the stakeholders or development practitioners or analysts, then it becomes a basis for indicating data to collect (what to measure) that will give the relevant indicators that will eventually indicate impacts on development (as shown in Table 2.2). The sources of information and methods of data collection can also be agreed by stakeholders before a case study is undertaken.

Table 2.2 Data Tables for the Assessment framework

	What to measure	Indicators & Units	Sources of Information	Data collection methods
Impacts				
Outcomes				
Outputs				
Activities/Inputs	Inputs			

2.4 The Fringilla Process

Development of the Preliminary Assessment Framework started with the development of skeletal and broad based causal chains indicating broad aspects of outputs, outcomes and impacts for the selected interventions in the participating countries. With that kind of the causal chain it would not be possible to allocate specific outcomes and impacts to specific areas of development, nor would it help in designing data collection surveys or research plan. At the second workshop held at Fringilla Lodge, Zambia (first week of June, 2006), the causal chains for the selected case studies were elaborated to show the energy services and development sectors that could be affected by the energy interventions and the direct and cross-linkages that can be realized e.g. from outputs to outcomes and subsequently from outcomes to impacts. At this stage the causal chain will have delineated the boundary of the intervention being investigated/evaluated.

In trying to make the AF simpler and easy to use, the most direct impacts (positive and negative) were linked to the outcomes. It is imperative that the outcomes be further translated in a terminology that can be easily linked to the development impacts and to universally accepted development objectives and goals such as the Millennium Development Goals.

Beyond the elaboration of the Causal Chain, the Fringilla Process involved translating the final causal chain into assessment data tables/fiches that contain "what to measure" and the related "indicators"' facilitating the identification of data requirements, potential sources of data and allocation of resources to the case study. Resulting from the development of the assessment data tables, it is then possible to develop the Research Plans for each of the Case studies. The Research Plans present the data collection methods adopted in the data tables, the respondents and sample sizes that are to be covered in the case studies. The plans also enable allocation of resources (human, money etc) and time allocation to the project. Hints to collecting unbiased and most representative data were provided by a specialized socio-economist (Box 2.1-Annex).

In the case study discussions (Chapter 3), the specific data collection methods used by each of the country teams are presented.

This process that has come to be termed the "Fringilla Process" is an important component of the AF in that it should bring stakeholders together to define their needs and priorities in the planning of projects and M & E. These needs and priorities should be disaggregated to be easily recognized in the process of data collection and indicator definition.

3 Case Studies

3.1 Case Study Selection

For the purpose of selecting the case studies, a set of selection criteria, comprising 6 local and 2 global considerations, was developed in collaboration with all project partners in the 6 participating countries. The agreed criteria are presented in Box 3.1

Box 3.1 Agreed Selection Criteria for country case studies

Local Criteria – seen from the point of view of the country team and the country

L1. National preference/relevance

L2. Development impact

L3: Availability of development impact data

L4. Availability of baseline

L5. Achievability

L6. Synergy with other development projects

Global Criteria – seen from the point of view of the DEA project as a whole – contributing to the quality and usefulness of the Assessment Framework

G1. Representative: The set of interventions in the Case Studies should span a number of different types of interventions or energy technologies in order to "test" or develop the AF.

G2. Illustrative value: The intervention may have high value in illustrating energy-development connections to other countries, i.e. intervention types that are common in other African countries.

The selected case studies for each of the participating countries are listed in Table 3.1.

Table 3.1 Selected Case Studies for each of the DEA participating Countries

Country	Selected case Study
Botswana	Grid Rural electrification supported by the Rural Electrification Collective Scheme
Ghana	Grid-based rural electrification
Mali	Women Renewable Energies Project
Senegal	PROGEDE (focus on improved stoves)
Tanzania	Small-scale irrigation using solar and wind energy
Zambia	Solar Energy Supply Companies (ESCOs)
Tanzania	Improved Cook Stoves- impact analysis[3]

3.2 Country Case Studies

Each of the case studies was presented as a summary providing background, assessment, results, summary table and stakeholder perspectives.

The background presented what the intervention is about, how it is implemented and funded, the implementing organizations and beneficiaries, scope of the project in form of extent and its objectives.

The assessment part includes the focus area for the project, the causal chain developed for the case study and the methodology adopted in data collection, including analysis where appropriate.

The results of the case study were summarized for each intervention or technology with respect to mainly outcomes and development impacts recognized. Results were presented in relation to the development sectors that are impacting on.

The summary table the intervention, the technology (ies) used, the hypothesized impacts in the causal chain and what has been verified by the case studies. There is also substantiation of what has been exposed by the studies and remarks that may be necessary to justify or point at peculiarities.

Stakeholder responses were the reaction of stakeholders to results of the case study presented at the DEA second national workshop, including their feedback on the AF and how it should be improved and disseminated.

All currencies of the six countries were converted to US$ using the average exchange rates of 2006 when studies were conducted and also presented side by side as PPP.

[3] Undertaken for a dissertation by student of Oxford University applying the Preliminary AF

3.2.1 Botswana Case Study - Rural Electrification by Grid Extension

Background

Botswana case study was on the Rural Electrification Collective Scheme (RCS) that supports Rural Electrification by Grid Extension (REGE). The RCS is a financing policy that assists rural customers in the form of a loan to reduce the burden of up-front costs of connecting to the electricity grid. Potential consumers form groups of 4 or more customers when applying for connection to benefit from economies of scale i.e. share the cost of extending the grid closer to their premises. This loan scheme requires potential grid electricity consumers to pay a deposit and make repayments over a period. The Scheme began in 1988 and has undergone several phases and modification with regard to deposits, repayment periods and loan interest rates (Table 3.2).

The Government of Botswana provides the funds used for the RCS and channels the funding to the Botswana Power Corporation that administers the loan and also implements the rural electrification programme on behalf of government. The beneficiaries of the RCS are households, institutions and business communities located in peri urban and rural villages.

Table 3.2 Evolution of the RCS

Year	Deposit (%)	Balance (%)	Repayment Period (years)	Interest rate %
1990	40	60	10	8
1995	10	90	10	9
1997 (standard costing introduced)	10	90	10	9
2000	5	95	15	Prime+0.5

The main objective of the RCS is to boost consumer connections to the grid. The BPC as part of the government infrastructure development brings the grid into the village and then potential consumers pay for linking their premises to the grid. In some villages, government has extended the grid to within 500 meters of the properties and in that case potential consumers pay a fixed amount for connection (about US$1000 per connection). The RCS does not cover wiring of the premises or provision of electrical appliances. Potential consumers that do not use the RCS have the option of connecting through hire purchase. Results of previous studies (EECG, 2004) however show that the majority (over 80%) of rural connections have been supported by the RCS, which meets the immediate objective of the energy intervention. The rate of connections also mimics the changes that have occurred to the RCS (refer to Table 3.2). The development objective of rural electrification like in other countries is to trigger rural development and hence reduce poverty in rural villages where, by comparison with urban areas, poverty is more rampant.

Previous evaluations of the RCS/RE did not make a development impact analysis and hence the intervention was recognized as an attractive candidate to test the Preliminary Assessment Framework. This case study was undertaken with the objective of exposing development that could be linked to the grid rural electrification and hence the RCS.

Assessment of the RCS/RE

Rural electrification through RCS covers villages throughout the whole country. The case study was undertaken in the village of Manyana (about 50km from the capital Gaborone). Of all the grid electricity consumers in Manyana, 82% have connected through RCS. And 18% through HP, indicating the RCS intervention is promoting grid connections as it was intended to achieve.

The key energy stakeholders endorsed the selection of the village for the case study. By Botswana standard, this is a medium type village with a population of 3200 (about 640 households). Most consumers were connected to the grid in the last 5 years and the sectors represented in the village include Health (1 clinic- electrified), education (1 secondary-electrified and 1 primary schools-partly electrified), government (tribal authority-electrified), communication (1 postal agency-not electrified), Small and Medium Industries (welding and sewing- both electrified), commercial (13 general dealers, butcheries, restaurants, bottle stores- 6 electrified) and the domestic sectors (about 640 households with 82% electrified).

Fig 3.1 presents the elaborated causal chain that was developed for the RCS/REGE and used to plan the data collection. The causal chain presents the linkages of RCS/REGE output, energy services and the sectors where the outcomes and impacts are realized, in the case of Manyana.

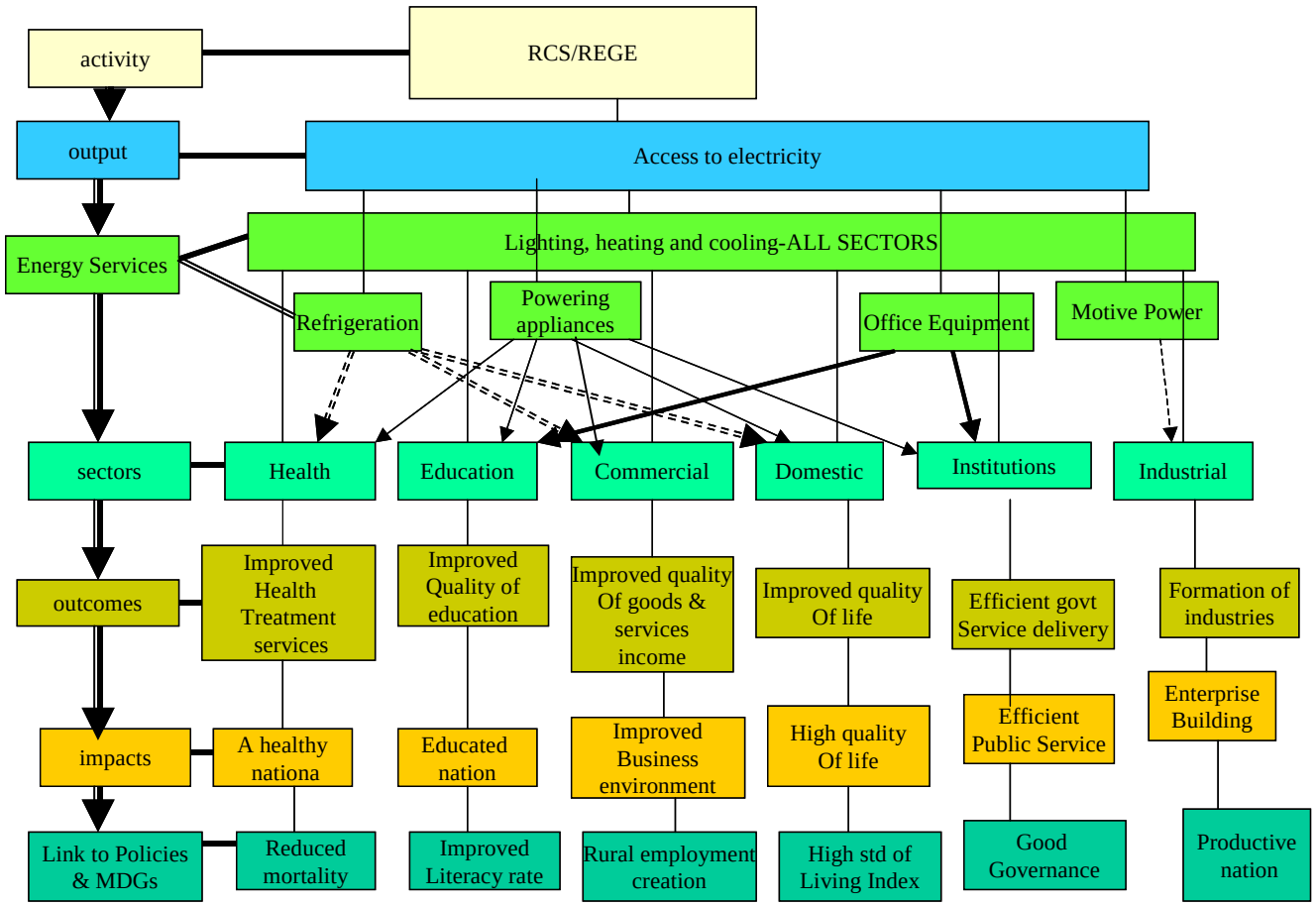


Fig 3.1 Elaborated causal chain of the RCS/RE and related sectors in Botswana.

From this causal chain, the desegregation of "what to measure" and the related "indicators" facilitated the identification of data requirements, potential sources of data and allocation of resources to the case study.

In undertaking the data collection, the following activities were carried out as part of data collection to assess the impact of the RCS/REGE on development in Manyana

- Reviewing of relevant literature including statistics of the Botswana Power Corporation with regard to connections in the village
- Visiting the traditional authorities (the Chief and Village Development Committee) to explain the project and make arrangements for focus group meetings. The authorities have influence on residents to cooperate in an initiative such as our case study.
- Identification of types of sectors that are operating in the village
- Development of questionnaires and guiding questions for informal interviews for respondents in each of the sectors identified.
- Undertaking interviews with selected households (10 electrified, 10 electrified with satellite dishes, and 10 un-electrified); representatives of schools (secondary and primary), clinic, commercial business (6), two industries (welding and sewing), and the Chiefs Office representative.
- Undertaking a focus group at the Chiefs kgotla consisting of both men and women. In the case of Botswana it was found adequate to combine women and men in the focus groups as women can freely talk in the presence of men and even hold positions in the Village Development Committee. The combined focus group meeting also avoided subjecting villagers to 2 meetings discussing the same subject within a short span of time, as this tends to create respondent fatigue.

It was also found out to be prudent to start with one to one questionnaire and informal interviews and conclude with focus group, as this was a way of authenticating the responses provided in privacy and an opportunity to probe further any issues raised at individual level.

The baseline adopted was the recall method. The method required stakeholders (electrified and non electrified consumers) to distinguish the change, which has occurred in their premises, village and to national development in general after electricity was connected.

The responses from questionnaires and informal interviews were recorded and entered into Excel for qualitative compilation. The compiled responses were then interpreted in the context of the predetermined "what to measure" aspects and the related indicators. Perceptions on the effect of RCS/REGE in Manyana were extracted and synthesized, qualitatively, including from the views expressed at the Focus group meetings. Several methods were used to identify consensus on the responses provided by the respondents.

Results of case Study

The results of the case study indicate achievements in development that respondents in the village attributed to Rural Electrification in Manyana village in relation to the sectors that are operating in the village, which are domestic/households, education, health, commercial, industrial and tribal authorities belonging to government.

An attempt was also made to categorize the impacts into social, economic and environmental but the majority of responses provided pertain to socio-economic impacts.

Domestic/Households

Household responses were obtained from electrified and un-electrified households and there was consensus on some impacts that affect the village and national development.

Electrified households now use a range of electrical appliances namely televisions, radios, refrigerators, kettle, irons, vacuum cleaners etc. In particular, households' respondents indicated that their lives had improved tremendously, among other things, through keeping food for a longer time through refrigeration and also having the opportunity to use radios and televisions. Those who cook with electricity indicated that cooking with electricity is faster than using other fuels particularly paraffin. Other electric appliances have facilitated accomplishment of household chores.

The village households are boasting of producing university graduates as electricity has provided a conducive environment for studying and allowed the use of modern education facilities such as computers and Internet.

Among the negative impacts mentioned are that some children are no longer performing well at school because they spend more time watching television. Another impression made was that the electrical appliances they have bought are attracting thieves.

In terms of how electricity has affected the village, electrified households indicated that, the village is more secure as a result of outside and streetlights. There is the realization that the village is developing through creation of electrified businesses, schools, clinic and kgotla (Tribal office) and working staff for these sectors were said to be staying longer serving the village than before electricity came. In addition villagers are able to use easy communication through cellular phones. In the past people used to go to the kgotla to ask for telephone but now they are within easy reach of their relatives and can share urgent information. Cellular phones have become possible because electricity is powering the cellular phone transmitters in the village for the main service providers in the country namely Orange and Mascom. Those with satellite dishes indicated that they are now better informed about global issues, which is also beneficial to their children studying in schools. Even the un-electrified households also echoed these same impacts.

Households also pointed out that general dealers and butcheries now operate for longer times than they used to do before they used electricity. People in the village have started small business e.g. tuck shops and Mascom public phone service shops, welding shop, tailor shop etc since electricity was connected.

In terms of what government development objectives have been met, some didn't know, or felt there was none but, some see improvement in education, health service sectors and hope that by 2016 at the end of Vision 2016, Botswana will be an educated and healthy nation partly through REGE. For education, the introduction of computers is seen as significant milestone in improving the quality of education. The

public office in this case the tribal office is seen to provide good service as a result of electrification. Household respondents however would like to see more government offices and businesses establishing in their village so as to create more employment opportunities.

Education (Schools)

The secondary school has electrified laboratories and classrooms and is using computers and other teaching aids such as televisions, videos. The indoor environment is also improved by use of fans. All these facilities were introduced when the school connected to electricity.

Indications from the school respondents are that students have not taken full advantage of the facilities that have been provided in the school as a result of electricity being available (computers, internet, lighting etc).

Those in the School that were interviewed are of the opinion that the goal of educated nation in the village can only be realized if children are encouraged to study hard starting from primary School.

The Primary School is partially electrified in that some classrooms are not connected, but the school also enjoys use of computers, photocopiers, televisions and radios. Responses provided by respondents of the school are that students that are using electrified classrooms are performing better than those who are in un-electrified classrooms but the same response was echoed that pupils are not taking full advantage of electricity in their homes and school to study.

In both schools, staff members/teachers indicated that they have stayed long at the school because the staff houses are electrified and comfortable.

Health (Clinic)

The clinic was electrified in 1999 and the outpatient clinic, maternity ward and three staff houses are electrified. The maternity ward is available for emergency. The clinic now provides hot water, refrigeration, television and HVAC facilities. An electric incinerator is also in use to burn clinical waste.

Since the clinic started using electricity, the number of patients has increased because new treatment facilities and medicines are available locally. Clinic staff indicated that in the past villagers used to travel to electrified villages like Thamaga (>20km) and Kanye (>70km) for such treatment and refrigerated medicines. The clinic can also now be consulted during the night if it's urgent. Clinic staffs now stay longer in the village, since they live in electrified houses.

Clinic staff indicated that villagers have benefited because they are exposed through television, to information about harmful diseases and how to prevent them e.g. HIV/AIDS when they visit the clinic. Respondents at the clinic indicated that the people in the village are now healthy and hence productive.

Commercial Sector (shops, restaurants, bottle stores and butcheries)

The electrified commercial businesses are also using a range of electrical equipment that includes refrigeration equipment, meat cutting and weighing/scales, cash register/tills, microwave, fresh chips cooker, televisions, kettle and heaters. It was difficult to extract turnover of these businesses but there is indication that quantity of stock has increased and some have introduced new products. For instance some

general dealers have introduced meat and cold drinks to their products since refrigeration is now available. For others the time of business operation has been extended but those that previously used generators have not changed their operating time.

On the negative side, electricity has created competition since more shops are selling similar products such as meat. Workers have also been reduced in some cases e.g. night watchmen who used to guard premises before businesses could electrify their outdoor lighting. Respondents from commercial businesses indicated they have become a target for thieves since thieves believe shops are making more money.

On meeting national development objectives, commercial business indicated that electricity created employment and income for the locals and brought development to the village.

Industrial (welding and sewing)

Welding is a business that could not have operated without grid electricity or generator and there are indications that the welding shop has produced many products including gates and burglar bars. The owner of the welding shop sees this as a contribution to boosting the local economy in Manyana by producing products for the local market, rather that the village depending on similar products produced from other locations. Before electricity came, the owner was alone but now employs 4 people. The business operates for 12 hours between Monday and Saturday and is realizing some profit (US$98[216][4]/month).

The tailoring/sewing business started recently in March of 2006 and uses electrical equipment as well. The number of workers is two and profit of (US$114[252]/month) is being realized.

The business owners see the contribution to development as providing services locally and being able to employ local people.

Tribal Office

The office believes that it is now providing a higher standard of service since electricity was connected. Apart from air conditioning facilities in the offices, the office is able to fax and type cases, letters and minutes of meetings quickly using electrical equipment. Staff in the village are also said to stay for a longer time because their houses are electrified and they have access to services like Internet, radio and television news.

The tribal office as the village authority indicated that some people who work in towns such as Gaborone now live in Manyana because there is electricity. The respondents from the Office indicated the hope that all tribal offices in the country will be electrified so that a higher level of government service can be provided.

There was confirmation from the focus group meeting that grid electricity had allowed residents to use modern appliances. Previously, cooking was done using fuelwood and the focus group pointed out that fuelwood scarcity is high and electricity has contributed to alleviating that problem.

[4] [216] Is purchase parity equivalent- See Annex for the PPP rates and exchange rates used.

The focus group was also able to point out where the implementation of REGE could improve in terms of customer relations and policy on cost of connections. This is seen as an opportunity for AF to feedback into project designs.

Summary on development impacts and MDGs

Table 3.3 provides the summary for the development impacts of the RCS/REGE and the link with the MDGs.

Stakeholder Response to the case Study

Stakeholders indicated that the case study results provided a confirmation of the development impacts that are usually hypothesized to occur but are never verified to have occurred

The use of more than one method (questionnaires, interviews, focus group, observation and literature reviews) for data collection is seen as important to improve on the reliability of the development impacts provided by respondents.

Some stakeholders suggested that AF should be able to generate more quantitative indicators, as decision makers often expect such. Stakeholders also wanted the case studies to present negative impacts and failures as well, which it was able to expose.

The anticipation of the stakeholders was that the case study would generate results that are representative of the impacts that have been realized nationwide as a result of RCS/REGE, but this was not the purpose of the study. The purpose of the study was to test the AF as a methodology of impact analysis or project evaluation and then pass it on to stakeholders in their respect roles as project implementers to use for project planning and M & E.

Table 3.3 Summary of development impacts and link to the MDGs for the RCS/REGE for Botswana

Intervention	Technology	Sector	Proposed link to MDG in Causal Link	Case Study findings & link to MDG	Substantiation	Remarks
RCS	Grid Electrification	Domestic	High standard of living index through high quality of life	Alleviating hunger MDG1	Food preservation using Refrigerators	These were substantiated by both electrified and non electrified households and the focus group
				Increased Literacy MDG2	Village boasting of creating graduates	
				Improved status of women-MDG3	Reduced effort in home for cooking and cleaning using electrical appliances	
				Empowered communities MDG3 & 6	Information flow and sharing using TV, satellite dishes and cellular phones	
				Reduced Impact on the Forestry environment MDG7	Villagers no longer depending on forest for cooking fuel	Now can cook with electricity as there is fuelwood scarcity
		Education	Improved literacy rate through educated nation	Improved quality of education MDG2	Modern teaching facilities in form of computers, internet and good lighting	Schools however believe students are not maximizing using these facilities
					Staff retention high	Teachers staying longer at school
		Health	Reduced mortality/health nation through improved health treatment facilities	Reduced Mortality Rate- MDG4&5	Improved health system & high medical staff retention	New drugs that need refrigeration
				Combating HIV/AIDS etc MDG6	Informed on spread of harmful diseases & prevention	Communication aids e.g. TV and videos available at clinic

					Prevention of disease spreading	Use electric incinerator to burn clinical waste
				Improved Maternal Health care MDG5	Attending to emergency cases in maternal ward	New appliances and lighting at clinic at night
		Commercial	Rural employment Creation/Poverty through improved business environment	Poverty Alleviation MDG1	Increased income of business	Increased volume of sales and new products introduced & extended hours & cooking appliances
					Increased local employment	More employees
		Industrial	Productive Nation through enterprise building	Poverty Alleviation MDG1	Rural development through new enterprises	Electricity facilitated welding and sewing industries
					Employment creation	Increased and new employment positions
		Government	Good Governance through efficient public service delivery	Government efficient partner in development MDG8	Efficient public service delivery	Use of computers for service delivery that used to be done manually
					Staff retention & performance	Conducive working environment-HVAC, lighting at office and houses

Representatives at the workshop from the key stakeholders (Department of Energy and Ministry of Finance and Development Planning) pointed out the potential of AF as a collective planning tool involving project beneficiaries and stakeholders. In general, the AF is seen as a useful tool for M & E of projects.

Stakeholders also believe that the AF can solve the challenge to group stakeholders for project planning hence the need for the creation of a Multisectoral Task group for project planning and impact assessment.

Stakeholders were also interested to know what will happen to the AF after the DEA project ends and who will own the product to roll it out emphasizing the need for an effective dissemination strategy for the AF.

The stakeholders that have been involved in the DEA project for a longer period would like to see the formation of a Multi-stakeholder Task Group (MTG) being coordinated by the Department of Energy.

3.2.2 Ghana Case Study - Rural Electrification by Grid Extension

Background

The Ghana Case study was on the National Electrification Scheme (NES) that was instituted in 1989 as the Government of Ghana's principal instrument to achieve its policy of extending the reach of electricity to all parts of the country over a thirty-year period from 1990 – 2020. At the beginning of the NES, only about 15% of the total population of Ghana had access to electricity supply. However, for the rural population who form more than 70% of the country's population, access to electricity was only 5%.

The NES is being implemented by the Electricity Company of Ghana (ECG). ECG brings the grid into the village and connects to those houses that have already wired their houses. Community members pay US$157.89 [914.21] for meters but even with that one's household needs to be near an electric pole. The cost of wiring households ranges between US$5.79 [33.52] and US$ 26.32 [152.37].

The goals and objectives of the NES are targeted towards:

- Poverty reduction, especially in the rural areas;
- Increasing the overall socio-economic development of the nation;
- Increasing people's standard of living, especially those in the rural areas;
- Creating small-to-medium-scale industries in rural areas;
- Enhancing activities in other sectors of the economy, such as agriculture, health, education, tourism, etc;
- Creating jobs in the rural areas and thus reducing the rate of rural to urban migration.

The NES covers the whole country but the case study was undertaken for the three villages of Ekumfi–Otabanadze, Ekumfi–Ekrawfo and Ekumfi–Atakwa and these are communities of the central region of Ghana. Sixteen years down the line the access to electricity nationwide has risen to 54% as at 2005. The case study examined the impact of the electrification on seven selected sectors (Agriculture, Small and Medium Enterprise (SMEs), Health, Education, Water and Sanitation, Communication and Technology, and Household) in the three villages

Ekumfi Otabanadze is a community of about 1000 people with 1 Kindergarten, 1 Primary School, and 1 Junior Secondary School and borehole potable water supply. The community has no well-defined market place, no rural bank, and no post office. Real access (number of households connected to the grid) in the community is about 75% and the electrification wiring is the single-phase type.

Ekumfi Atakwa is a community of about 800 people with 1 Kindergarten, 1 Primary School, 1 Junior Secondary School and drinks borehole water. The community has no well-defined market place, no rural bank, and no post office. Real access to the grid electricity in this community is about 40% and has also a single phase transformer

Ekumfi Ekrawfo is a community of about 1700 people with 1 Kindergarten, 1 Primary School, 1 Junior Secondary School and drinks borehole water but has pipe borne water, which is not very reliable. The community has a well-defined market place, no rural bank, and a post office. There is a private clinic, which is about 100 meters away from the community. Real access to the grid electricity in this community is about 75% and the wiring type is 3-phase type.

The causal chain that was developed for this case study is presented in Fig 3.2 below and data collection was designed based on the this chain. The Ghana causal chain was developed along the same format as the Botswana causal chain since they are both rural electrification by grid extension.

Data has been collected through questionnaires, which targeted the three communities. Using the "Fringilla Approach[5]", the communities were divided into seven sub-sectors viz. Water, health, education, communication, household, small and medium enterprises, and agriculture. Questionnaires were developed based on tailored needs/indicators of the various sectors. In all three villages the following methods were used for data collection:

- Questionnaires – questionnaires were developed with the indicators and what to measure etc. Data from the field study was collated and analyzed for direct and derived conclusions.
- Close and personal observations of respondents and facilities within the communities, and
- Desk study from different reports such as the Achievements of the National Electrification Scheme (NES), and Internet.
- Focus groups

[5] The Fringilla Approach sometimes called the Fringilla Process is the approach developed by the representatives from all the six countries participating in the DEA project

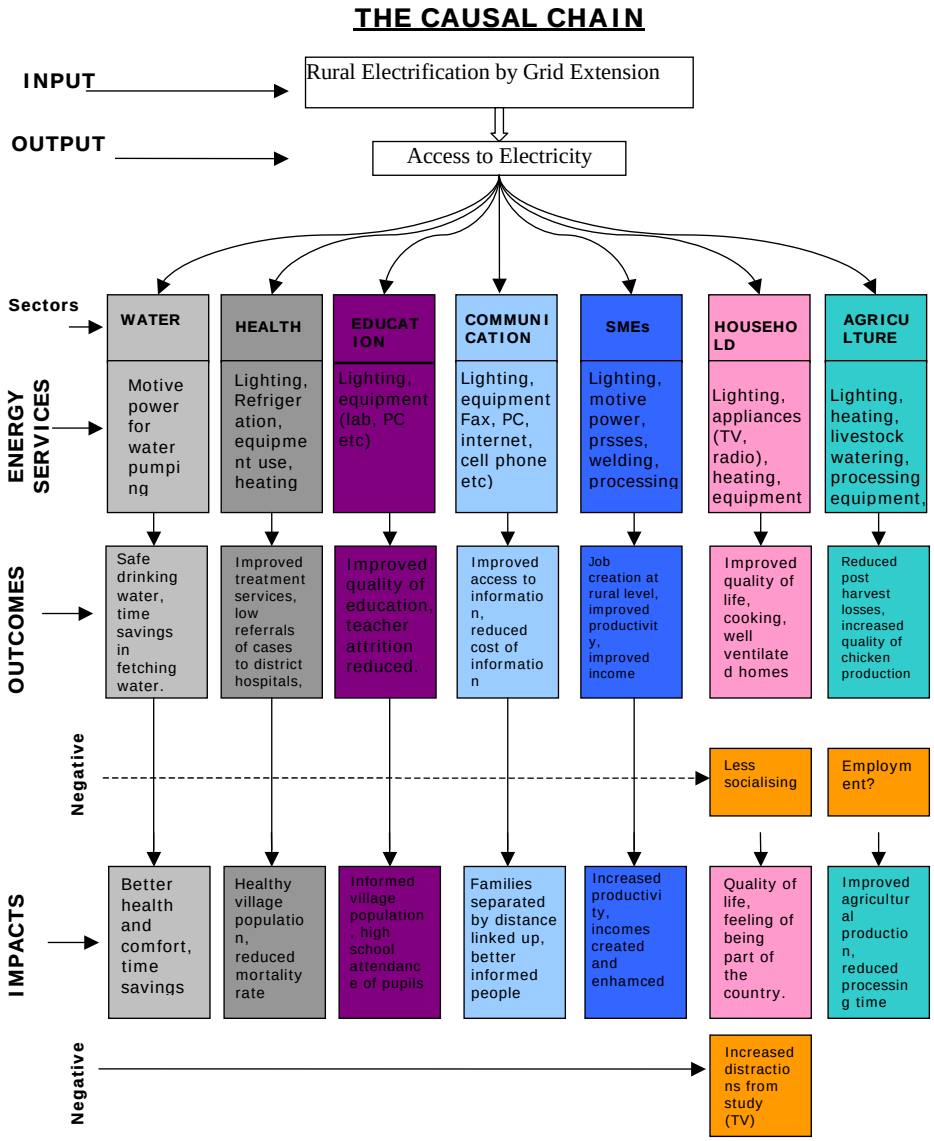
Focus Group Discussions preceded the other entire individual one-on-one interactions and questionnaire administration in all the three communities. This was also to ensure that prior to visiting individuals in their households they would have had knowledge of the case study and that would shorten the time spent explaining the process to every individual at the household level.

Three focus groups were undertaken- one with both men and women and additional ones with men and women separately. The latter was necessary because in Ghana communities are dominated by men and women would not easily share information until after the men have spoken.

After the focus group meetings, questionnaires were administered to households, SMEs, the schools and clinics. The project also adopted the recall baseline method that required respondents to distinguish change before and after electricity was connected in their village.

Data collected was analyzed with reference to the various sectors identified in the causal chain (Fig 3.2).

Fig 3.2 Causal Chain for the NES case study of Ghana



Results of The NES Case Study

Household

At household levels, there is evidence that access to electricity in two of the 3 villages significantly increased (75%) for households in the 8 years after introduction of NES in those villages. There is however evidence that other energy fuels such as charcoal, fuelwood and kerosene are still being used in the villages mainly for cooking. The impact of electricity however is seen in the fact that kerosene is no longer the main lighting fuel. Some kerosene, torch -battery and very little candle use continues for lighting during outages. There was general agreement that the advent of electricity had greatly reduced expenditure on energy.

The advent of electricity was also indicated to have led to acquisition of various electrical appliances in all the three villages that include Television sets (25% ownership), Radio-cassette recorders (44%), Refrigerators (25%), Fans, Blenders, Lighting bulbs, Pressing Iron (20%), Water Heaters, Video cassette players and CD players. All electrified households had a number of these appliances. Prior to that most households only owned portable radios powered by batteries and only one household had a black and white television also powered by battery.

Electricity installation did not provide jobs for village communities since contractors brought their own workers from elsewhere. The communities only helped in kind.

Refrigerators however enabled marketing of iced water and other frozen items at household level and that boosted household incomes for those with electricity and refrigerators.

Communities confirmed that availability of electricity has benefited social knowledge on national and global events and gender issues and increased collective socialization in community events such as funerals and weddings.

Health

Although figures of change could not be provided, communities were quick to say that the advent of electricity reduced health risks of eye illness and respiratory diseases. There was also useful information on radios and televisions to inform them about health matters hence increasing their awareness on health issues.

Education

The teachers interviewed indicated that general performance of pupils had risen to a higher level but the link with enrolment could not be confirmed. There was confirmation of staff retention and attraction of high quality teachers to the villages as a result of availability of electricity. The negative aspect was that some school children were socially misbehaving taking advantage of availability of electricity.

Both tabletop and cell phones (40% of respondents) are being used in the villages and electricity contributed to their advent to the villages. Apart from connecting communities with their relatives far away, they also save transport costs as a result of such communication facilities.

SMEs

In the two villages with single-phase electricity, no jobs were created as a result of advent of electricity, since industrial machinery could not be connected for use in the villages with single-phase electricity. Even in the village with 3-phase connections, not many jobs were created and the reason given was that there was no capital and the market could not sustain the businesses that had started. This emphasizes the need to look beyond just the provision of electricity and assess the other factors that are necessary to drive development.

In the three villages, only six business namely photo-studio, Mini market (provision shop), Terrazzo works shop, hair salon, food-vending spots, and pottery. The provision shop, hair salon and pottery existed before electrification and had still not moved away from the traditional ways of operation, so they were therefore not directly using electricity in their operations. However, they all indicated that access to electricity had enabled them to extend working hours so as to work even at night thus boosting their production or service delivery. This has had the trickling effect of making more financial gains from the businesses and in some cases increase in the number of employees.

The photo studio owner had benefited immensely from the electrification since all his activities depended on electricity and will probably not have set up the business if there was no access to electricity. The studio uses electricity for developing films. The terrazzo shop also depends on electricity and was only established after electrification extension to the villages. The businesses indicated that they are providing a wider range of service as against their counterparts in other communities that do not have access to electricity. They are more conscious of providing quality service because people have become more enlightened and would demand higher quality service delivery and products. The quality of services has also engendered the increase in patronage of products and services.

Summary Development Impact Analysis

Direct poverty reduction could not be established and communities did not consider themselves richer than before the electricity. Poverty Reduction is also difficult to measure as an impact and often cannot be firmly established because even where incomes do increase the impacts may be masked by other factors that have influenced standards of living such as increase in fuel prices with the corresponding increase in prices of goods and transportation.

Communities have benefited socio-economically although not in measurable terms. This benefit is in form of acquisition of assets and being informed on issues that affect their lives e.g. health matters. They are also exposed to national and global trends, gender and human rights issues.

The general standard of living has been enhanced by availability of light that allows them to socialize at night and bring security in their lives.

Creation of SMEs was limited and this is attributed to single-phase connections in two of the 3 villages, but also attributed to lack of capital and markets in the 3rd village with 3-phase electricity. This confirms the need for all stakeholders to plan together if rural development is to be achieved. Provision of Electricity alone cannot create businesses.

There has been evidence of electricity benefits in education with respect to student performance and also to the clinic treatment facilities. Since the establishment of the clinic there has not been a record of maternal death in the communities. Thus there is the need to establish health centres alongside providing electricity to help realize MDG 5.

There was evidence of health improvement due to electrical lighting (replacing kerosene and candles) but presumably, the persistence of cooking by biomass fuel means that indoor air pollution remains and is a major contributor to illness. This means that for an accelerated increased positive impact in the health sector other initiates that for instance makes available improved stoves or fuel switching need to be implemented alongside the provision of electricity. This holds for all the other sectors in order to ensure an all round development within the rural communities.

The study in a number of ways highlights the key point that electricity is an important but not sufficient input to development. Other important factors that need to be present to ensure development is achieved are capital/financing, markets and other infrastructure.

The link of the achieved development impacts to the MDGs is presented in Table 3.4.

Table 3.4 The Summary linking development impacts to MDGs for the NES of Ghana

Intervention	Technology	Sector	Proposed link to MDG in Causal Link- here given as impacts	Case Study findings & link to MDG	Substantiation	Remarks
National Electrification Scheme (NES)	Grid Electrification	Household	Quality of Life	Household income improved- MDG1	Selling of refrigerated items	Use of refrigerators possible
				Empowerment of communities- MDG 2, 3, 6	Knowledge on national, global, gender issues	TV and radio facilities
					Increased socialization time	Due to availability of lighting
		Education	High school attendance	Better pupil performance in schools MDG2	Attraction of high quality teachers & retention	Conducive living environment as a result of electricity
		Health	Health Community	Reduced diseases incidences & increased safety- MDG6	Reduced risks of eye and respiratory diseases & no maternal death; no more snake bites	Due to good lighting

			Reduced mortality	Empowered community on health issues MDG 4,5 &6	Informed about health matters	Through radio and televisions
		Communication	Informed communities & nation	Better communication & avoided costs MDG1	Use of tabletop and cell phones, saved transport costs	
		SMEs	Increased productivity, income creation and enhancement	More financial gains and employees- MDG1	Existing business- extend working hours	Single phase electricity & lack of capital& markets hampered setting up of industrial plants
		Agriculture	Improved agricultural production	Not using electricity		
			Reduced processing time			
		Water	Better health	Not suing electricity in the village		
			Reduced time burden			

Stakeholder responses

It was observed that all the communities involved in the surveys were localized – all in the central region and did not serve as a fair representation of the situation in the nation but a representative of the Electricity Company of Ghana (ECG) indicated that the results were similar to other case studies that had been carried out in other parts of the country.

The case study was used to test the adequacy of the Assessment Framework and as such could be adopted for wider scale studies. More finances could be sought from interested parties and organizations like ECG, Volta River Authority (VRA) etc to carry out such further impact assessment.

Attention of participants was drawn to the importance of taking the cultural difference and practices into considerations when interpreting results of such case studies because differences in culture influence the behavioural patterns of societies and hence the impact of interventions.

Participants unanimously commented that the Assessment Framework was a very good and useful tool and the next step was to explore ways of integrating it in all the sectors for proper planning and evaluation of interventions.

Participants consented to the fact that the policy needed to complement such energy interventions to ensure success was missing and that other sectors concerned needed to get on board in order to have the synergy to realize increased and useful outputs. They further continued that a platform was needed to place energy in its right place of developmental issues.

In their final remarks participants were of the view that the Assessment Framework will be very useful not just in assessing energy interventions but it could be used in other sectors as well. Participants from the Energy Commission indicated their willingness to meet with the DEA team for further deliberations on how to integrate the AF in their activities. A meeting was arranged and the EC found the AF to be a very useful tool and would want to use it in its activities.

Stakeholders asked if the next national workshop could be used as a 'TRAINING WORKSHOP' to offer training to the EC and any other institutions that would find the AF useful, as this will serve to help integrate the AF in the institutions' activities.

3.2.3 Mali Case Study - Women and Renewable Energy project

Background

In Mali, the **Women and Renewable Energy project** was selected for a case study to test the Assessment Framework tool. The WRE project is an initiative of the Malian Government in response to the International Conference on Renewable Energies, held in Nairobi, in 1981. The Nairobi conference recommended the active involvement of women in the different energy decisions making, because they are producers, users, and managers of various energy sources.

The expected budget of the project was **US$124,339,623 [3, 469,075],** out of which **US$1,132,075.47 [3, 158,490.57]** was provided by the UNDP and **US$111320.75 [310584.91]** from the Government of Mali.

The WRE project was implemented in two phases: the pilot phase and the implementation phase. The pilot phase started in 1992, and ended in 1995. This phase covered 41 villages in the region of Kulikoro. The positive outcome of this phase motivated the beginning of the second phase, which started in 1996 and ended in 2001. This phase is called the implementation phase and covered 90 villages in the regions of Sikaso and Segou.

The National Directorate of Energy within the Ministry of Mines, Energy and Water, supervised the project in collaboration with a technical committee composed of 20 technicians some of which came from the National Directorate of Women Promotion. The implementation of the project was carried out by the National Centre for Renewable Energies. Other institutions such as the Directorate of non-formal education, Regional Development Centers, NGOs, and the private sectors participated in facilitating the implementation with the recipient villages.

The Women and Renewable Energy Project aimed to promote the utilization of renewable energy to fight desertification and poverty, and to protect the environment. The project also aimed to encourage the participation of women in development programmes, particularly in the energy sector to improve their conditions.

Through the project, solar lighting systems, solar hot water and solar dryers, wind water pumping systems, and multifunctional plate-forms using jatropha oil, were installed in a total of 130 villages located in three provinces Mali.

The solar lighting systems were installed in the health and literacy centres. Solar water heating systems were installed in the health centres and the wind water pumping systems were installed in the village market gardens. Solar dryers were installed in fruits and vegetable areas for the rural women associations. Multifunctional plat forms using jatropha fuel were installed for women in villages having a potential for the cultivation and production of jatropha fuel.

In addition to the equipment installed, the project also prepared manuals on the operation and maintenance of the systems. Many women received training on income generation management and the general aspect of renewable energy technologies. The documents and trainings were to create a commitment and interest of people in renewable energy technologies. The project was also to lead the population to a better understanding of the role that renewable energy can play in the protection of their environment.

Assessment of the WRE Project Case Study

The study was carried out in eight villages of **Konodimini, Koula, Massala, N'Gara, Somonodougouni, Tombougou, Wolonkotoba, Zambougou** in the provinces of Koulikoro and Ségou. Data and interviews were collected with recipients groups.

This characterization of the project activities and the hypothesized impacts are depicted in causal chains for each of the technologies installed as part of the WRE project Fig 3.3 to 3.7)

From the causal chains, the data requirements and indicators were developed for purposes of undertaking data collection.

The methodology used by the team consisted of a literature review on the various activities of the project in order to get background information on the objectives, the main recipients, the type of technology installed and the geographical location where the technologies were installed. The literature review facilitated the choice of the villages where the field research was conducted. The choice was based on the number of technologies installed in the village. With such methodology it was possible to have at least two villages using the same technology, and hence to compare the data from the villages.

The case study survey started with the Mayor and the Chief of each village, who then called all the people involved in the management of the equipment, and also people who are the main recipients.

Focus group interviews were therefore conducted with representatives of the main recipients in the villages (health and literacy centres, and women associations). The main recipients of the WRE project as the project title shows are the women.

In the health centres, matrons and pregnant women were interviewed since they are the main users and recipients of the solar hot water and solar lighting system installed.

Solar PV modules were used for the lighting of health centres and the literacy centres. These centres are useful for the entire community. Interviews were carried with the direct recipients of the technology in order to collect their views and impressions on the advantages of the technology, and evaluate the impact of the technology on the rate of literacy and the improvement of health services.

Most of the solar dryers were installed for village associations. They were used for vegetable drying such as onions, gumbo, pepper, and fruits (mangoes) etc. Such activities have become a source of income for the associations. To measure the impact of the dryers on the association income generation, interviews were carried out with the main managers of the technology.

Wind technology was used for water pumping for gardening. In most cases women and children do this activity. The interviews were therefore carried out with women and children working in the garden of Zambougou village.

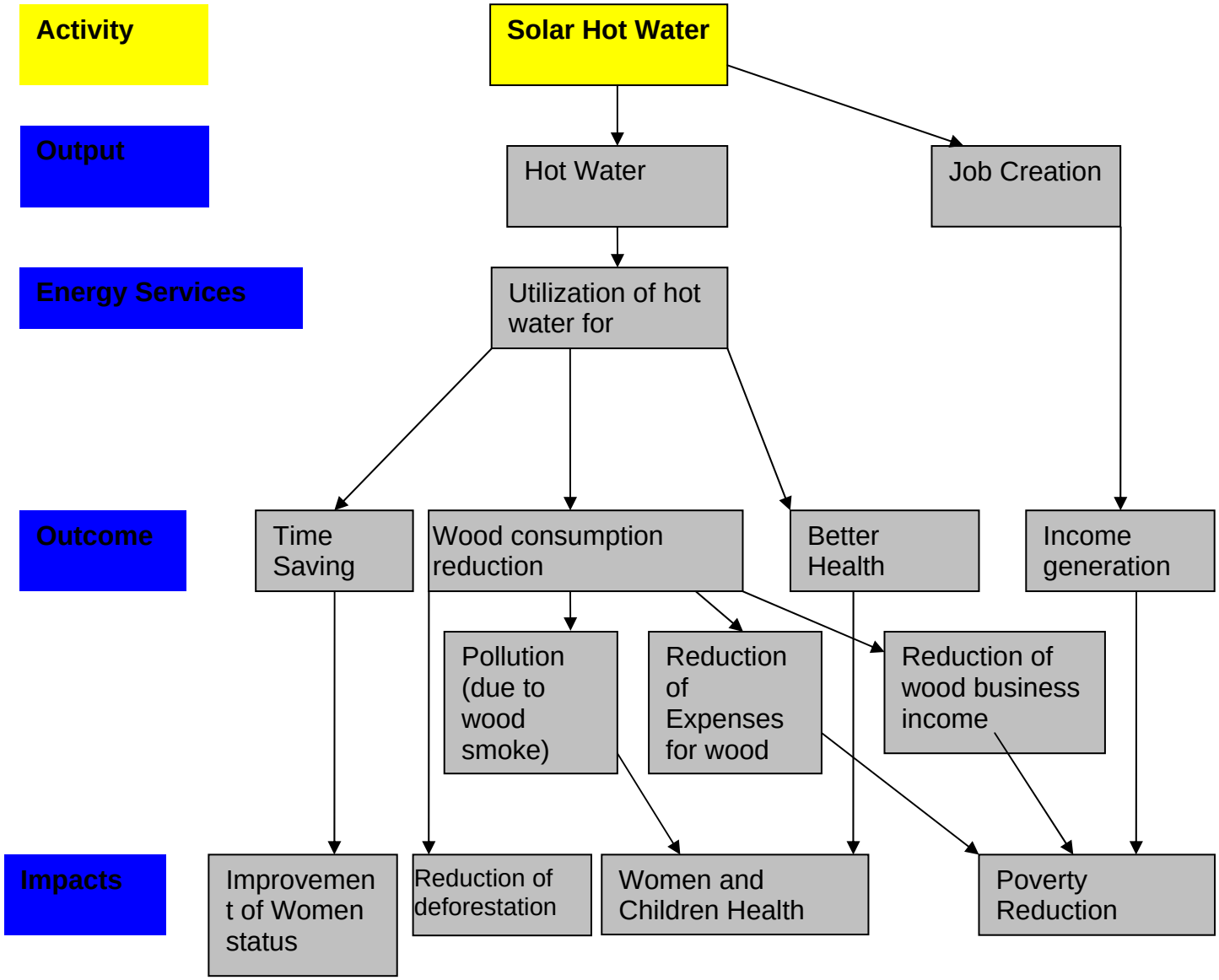


Figure 3.3: Causality Chart for the Solar Water Heater System

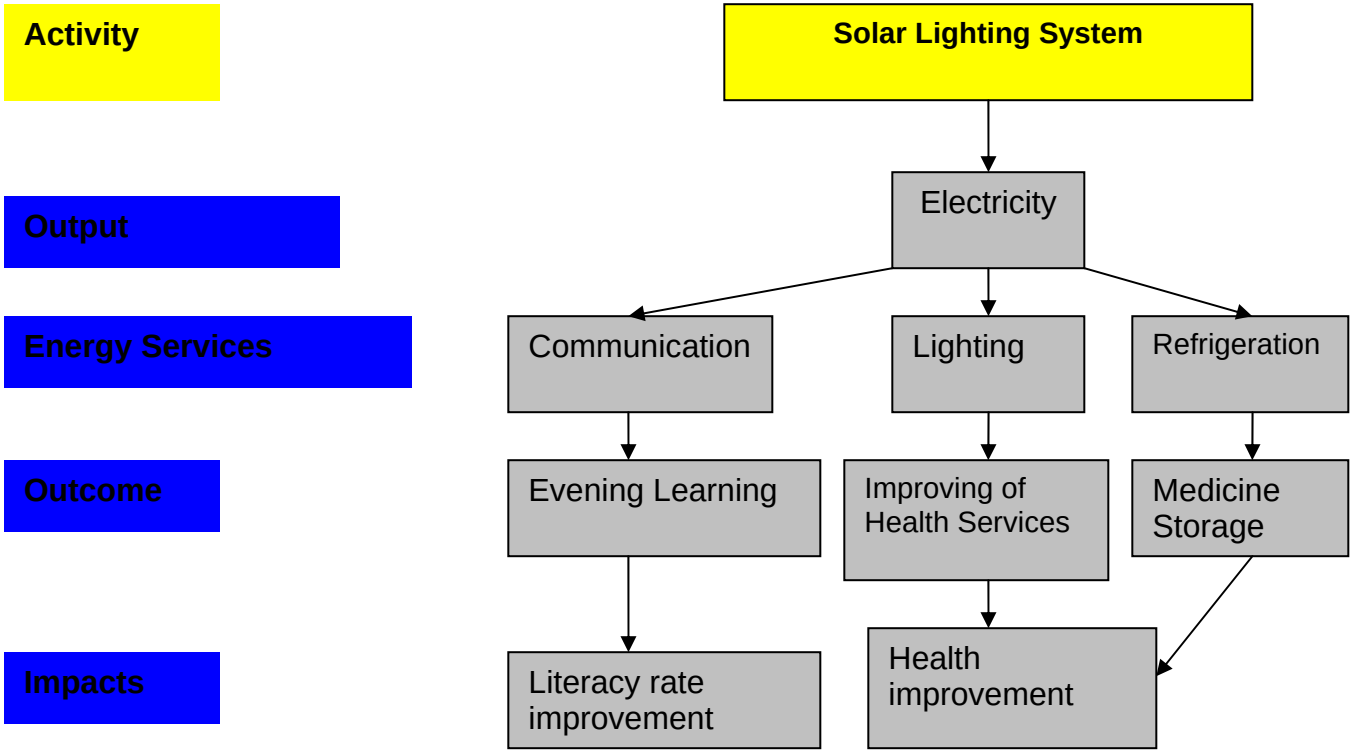


Figure 3.4: Causality Chart for the Solar Lighting System

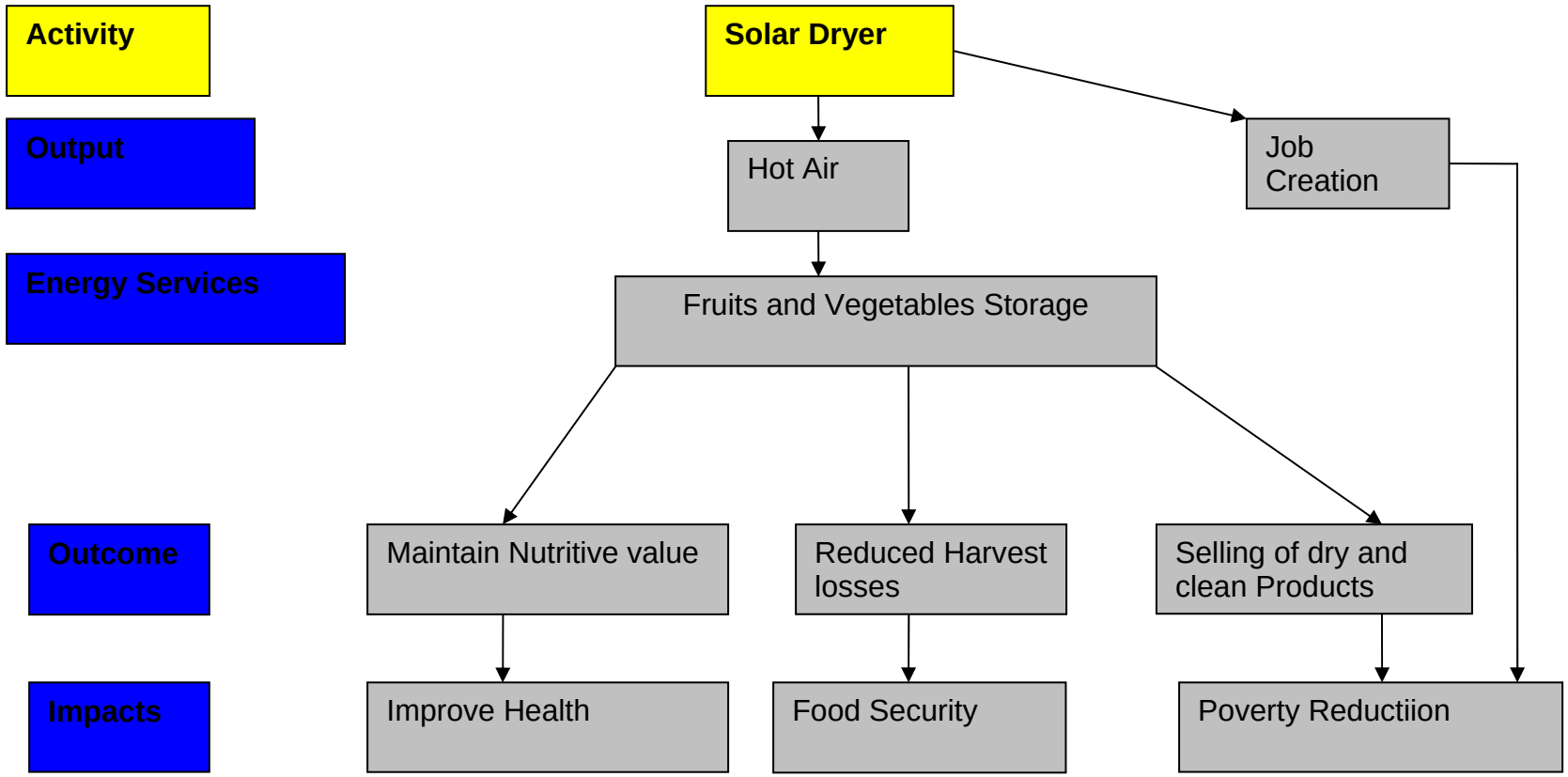


Figure 3.5: Causality Chart for Solar Dryer

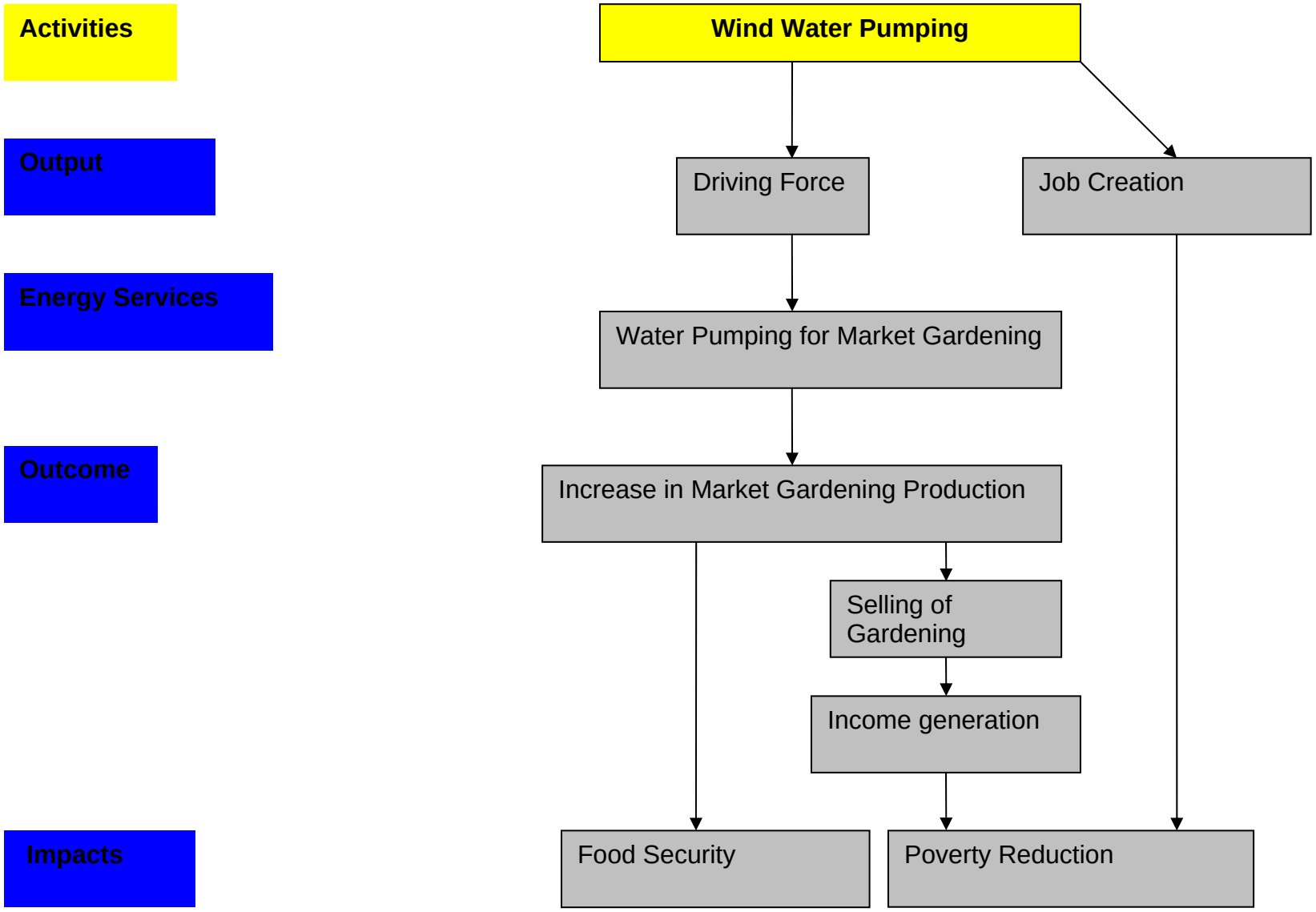


Figure 3.6 Causality Chart for Wind Water Pumping System

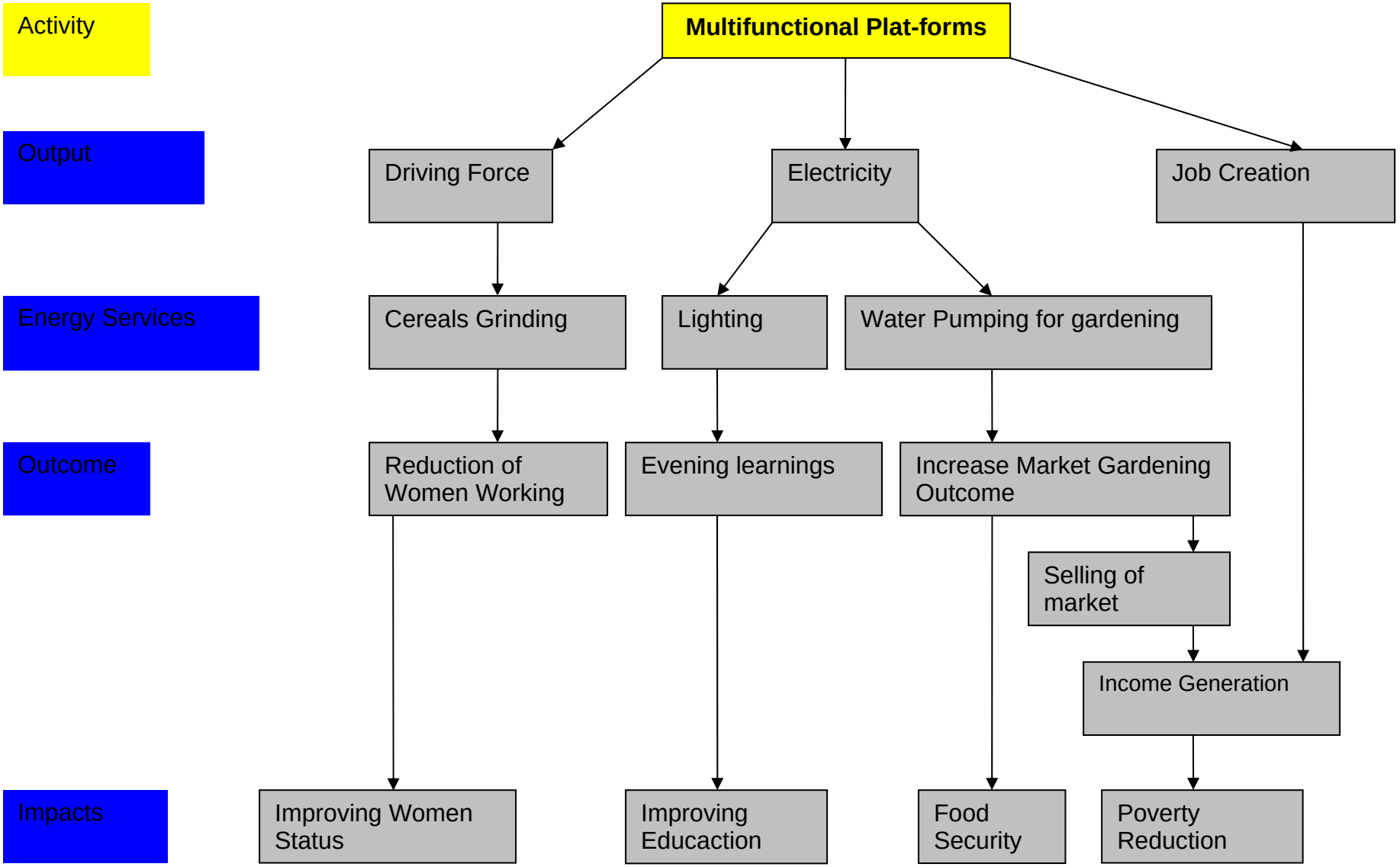


Figure3.7 Causality Chart for Multi Functional Platform

The multifunctional platforms were installed for women associations that were managing daily operations of these multifunctional platforms and also represent the main recipients of the technology. In the N'Gara village, the interviews were conducted with the manager of the platform, the president of the women association (a women), and some members of the association.

Analysis of the data collected during the discussions and interviews with the main recipients of the project led to the classification of the impacts of the WRE project into three types, namely:

- Environmental impacts
- Social impacts
- Economic impacts

The above three impacts were evaluated for each technology through quantitative and qualitative indicators showing the impact of the WRE technologies as seen by the recipients.

Results of the Case Study

The presentation of results in the Mali case study was technology based to reflect the social, environmental and economic impacts of each element of the intervention.

Solar Water Heater

Basing on the statements of appreciation provided by the respondents, it was established that the availability of solar hot water technology in the health centres has led not only to the improvement of health services in the centres, but also in reducing the risks to which women are subjected to in their struggle to find hot water for both the mother and her newly born baby during child delivery at clinics.

In addition to the above facts, each solar water heater meets the needs of 228 women per year that come for child delivery.

The saving in fuelwood use is estimated to be 3 330 tons over 15 years lifetime of all the 74 solar water heaters installed by the WRE project. Forest resource exploitation was calculated to translate to 333 ha, representing 4.5 tons of CO_2 avoided. In that regard, it can be inferred that the diffusion of solar hot water contributes to fight deforestation

Economically, it was calculated that patients coming to deliver at clinics that now have solar water heaters are saving US$0.06 [0.17] for wood (against what is paid now for access to hot water from solar water heaters) that was used to heat the water per woman (a total of US$1,018.69 [2,842.14] per year and US$15,280.30 [42, 632.04] within 15 years for all the individuals assisted at the clinics served by the WRE project. On the negative side, these savings may represent a loss for wood sellers.

At community level, income accruing from access to hot water from solar water heaters was estimated to be US$43.02 [120.02] per year per centre and the annual net benefit for each centre (income generated less annual cost of the system) amounts to US$8.43 [23.51] per year. For the 74 centres equipped with solar water heaters, the benefit amounts to US$623.69 [1740.11] per year and US$9355.42 [26, 101.61] within 15 years.

Solar lighting

Available data shows that most of the child deliveries in clinics happen at night and according to the recipients, solar lighting contributed in improving women delivery conditions in the health centres. Previously women used kerosene and incidents of fire hazards were reported in the past

In the literacy centres, the recipients indicated the main advantages as increase in attending literacy classes, increase in the number of hours available for classes, and better conditions of learning. The possibility of getting a better job as a result of literacy classes was also quoted as a positive impact. Kerosene was obtained from far places creating the burden of procurement. Respondents indicated that kerosene lamps lighting required more energy for reading, and put more fatigue on the eyes

Environmentally, respondents indicated that kerosene lamps produce smoke "and we can even feel it in our throats". Basing on previous consumption of kerosene it was also possible to compute the CO_2 avoided of 153 kg of CO_2 per year for each health centre and 307 kg of CO_2 per year for each literacy centre. The emission reduction of 347 tons of CO_2 over the 15 year-life-time for all the 113 lighting systems in both the health (75) and literacy centres (38) was deduced.

Financially, it was calculated that individuals have avoided expenditures of the lamp kerosene (minus cost of using solar lighting) each woman used to purchase during her stay in the health centre per child delivery of US$0.09 [0.26] per day. The annual saving is therefore estimated to be US$21.51 [60.01] for the users per centre and a total saving of US$24,198.11 [67, 512.74] within 15 years for the 75 solar lighting systems.

Revenue accruing to community selling the services of the solar lighting systems result in a net benefit for the health centre (income generated – annual cost) of US$35.47 [98.97]. For the 75 health centres equipped with solar lighting system the net benefit amounts to US$39,905.66 [111, 336.79] in 15 years.

In the case of the literacy centres, the calculated saving of shifting from the kerosene lamp to the solar lighting gives US$116.98 [326.38]. Considering the 38 solar lighting systems installed in the literacy centres, the total saving for the community is US$73,132.08 [204, 038.49] within 15 years.

The economic savings resulting from the utilization of solar lighting systems are believed to contribute to fighting poverty at individual and community levels but this is an inference.

Solar Dryers

Solar dryers were installed by village women association who use them to dry fruits, vegetables, cereals, meat, etc. Respondents were able to confirm that:

Solar dryers reduce contamination of foods by flies, sand, dust and other particles as compared to the traditional open sky drying method. Solar dryer products are therefore of higher quality as compared to the traditional way of drying.

- Solar dryers prevent production loss and saves time of drying products
- Communities have learned market gardening products drying techniques. This is an advantage, since market gardening remains main activities.

On the economic impact the calculated net income generated for the women association per year (annual earning – annual cost) amounts to US$478.44 [1334.84] (US$90,424.38 [252, 284.01] within 7 years of life time of 27 dryers installed by the WRE project). This shows that solar dryers can generate income

through the selling of dried products, thus contributing to fighting poverty, which is the main objective of the WRE project.

Wind water pumping

The women benefiting from the water pump were relieved of the burden of fetching water from a well of 30m depths, which was very tiring and was a barrier to production, since the plants could not have enough water. With the wind pump, they have been able to increase the surface area of production and therefore the overall production has been increased'.
Economically, individuals as well as communities benefited. Revenue accruing to individuals was estimated to be US$141.51 [394.81] per user per year and US$8301.89 [78, 962.26] per year for the 200 women involved in the gardening activities. Therefore the two-wind technology installed through the WRE project can generate revenue of US$849,056.60 [2, 368,867.92] during 15 years.
In the case of communities, revenue from access to water versus investment and O & M of the water pumps was calculated to result into a net benefit of US$50.06 [139.67] per year accruing to each village community that owns the water pumping system.

Multifunctional Platforms

The multifunctional platform is used for cereal grinding, electricity generation, and water pumping for the market gardening. The women have now been relieved of spending long hours and drudgery of grinding cereals, water fetching, etc. Respondents in the village confirmed in this case study that waking up very early or sleeping late grinding cereals or fetching water " have become things of the past'. Estimated relief is reducing the workload of 20 to 50 women in the village per day. For cereal grinding alone the time saving is estimated to 2 hours per day'.

The realizable environmental impact would have been the use of Jatropha oil as fuel to run the platform but low production of seed has hindered that. Apart from environmental benefit previous study revealed that the utilization of jatropha oil as fuel instead of diesel can make an average saving of US$1752.45 [4889.34] per year per platform with additional income from sale of jatropha seeds, the production of jatropha oil, the valorisation of the by products such as fertilizer, medicine, insecticides, cosmetic products, and soap.

Economically it was calculated as part of this case study that each multifunctional platform can generated a net income of between US$47.17 [131.60] and US$56.60 [157.92] per month from water pumping (supporting gardening activities), for batteries charging, for lighting, and grinding of cereals. This represents an annual income of US$622.64 [1737.17] for the women association. For the 16 platforms, this represents a net income of US$9962.26 [27794.72] per year and US$149,433.96 [416, 920.75] over the 15 years lifetime of these platforms.

Additionally, women are now participating in the activities of the association and generated US$754.72 [2105.66] from trees planting for the city council in one year'. They are able to participate since they are relieved of time by the platforms.

The summary showing the development impacts realized in relation to the MDGs is presented in Table 3.5.

Table 3.5 Summary of WRE development Impacts and linkages to MDGs

Intervention	Technology	Sector	Proposed link to MDG in Causal Link- here given as impacts	Case Study findings & link to MDG	Substantiation	Remarks
Women Renewable Energy Project	Solar Water Heater	Health	Poverty reduction	Improved income for individuals and community MDG1	Savings on purchase of fuelwood of US$0.06 [0.17] per visit to clinic & income of US$8.43 [23.51] per yr per health centre for provision of hot water	Wood traders are losing part of their market
			Women and Children Health	Better health care of mother and child at clinics- MDG4 & 5	Provision of hot water at delivery times for mother and new baby	Used to be difficult to get using wood fire when sick
			Reduction of Deforestation	Avoided forest resource depletion MDG7	Calculated to 333 ha and 4.5tCO_2 avoided	
			Improvement of Women	Reduced burden on hot water provision MDG3	No more providing fuelwood for hot water	
	Solar Lighting System	Health	Health Improvement	Reduced maternal mortality MDG 5	Safer baby delivery at night	Statistics at health centres show most babies delivered at night
				Poverty alleviation MDG1	Individual net benefit of shifting from kerosene US$21.51 [60.01] for users at each health centre per year	
					Community revenue US$35.47 98.97] per yr per centre	
		Education	Literacy Rate improvement	Literacy delivery improved MDG2	Better learning environment & extended hours in class at literacy centres	
				Poverty Reduction MDg1	Educated women become employable	

					Benefit of shifting from kerosene US$128.30 [357.96] A/literacy centre	
		Combined Health & education		Environmental sustainability MDG7	Avoided CO_2 of 347tons over 15 years	Avoided from use of kerosene
	Solar Dryer	Agriculture	Poverty Reduction	Income generation MDg1	Community net income of US$487.44 [1334.84] per dryer per year	
			Food security	Reduced production loss MDG1	Avoided loss of perishable fruits and vegetable	
			Improved Health	Reduced food contamination MDG1	Avoided effects of flies, dust etc	
	Wind Pump	Agriculture	Poverty Reduction	Income generation MDG1	Individual US$141.51 [394.81] per year; US$50.06 [139.67] per yr per village community	Individual income from sale of garden produce; from sale of water pumped for community income
			Food Security	Reduced burden on women MDG3	Used to Fetch water from a 30m deep well	
			Food Security	Increase in productivity MDG1	Increased water for plants	
	Multifunctional Platform	Household/community	Poverty Reduction	Community Income generation MDG1	US$47.17 [131.60] – US$56.60 [157.92] per month (US$622.64 [1737.17]/yr) per platform;	From services of pumped water, battery charging, lighting and grinding of cereals
					Indirect income due to freed time of US$754.72 [2105.66] per yr per community	

			Food security	Alleviating hunger and improving income MDG1	Through food processing at multifunctional platforms	
			Improving Education			
			Improving women status	Reduced burden on women MDG3	Fetching water and grinding cereals is a thing of the past; 2 hours time saved estimated.	

Stakeholder responses Mali

The stakeholder participants appreciated the innovation of the DEA project in trying to take into account the synergy between the different sectors of the development and recommended the following

- To compare the results of impacts assessments already carried out with the results obtained with the assessment framework developed by the DEA project;
- To refine the DEA Assessment Framework and make the steps and tools more explicit
- To share with the stakeholders all the documents and results of the DEA project.
- To train a group of people in the utilisation of the DEA assessment framework

3.2.4 Senegal Case Study- Improved Cook stoves

The case study for Senegal was on improved charcoal and fuelwood stoves that have been introduced by government services through the PROGEDE project. The project consisted of three components: preparatory and support activities, sustainable wood fuels supply management and demand management and Inter-fuel substitution options. The project design included a series of activities to ensure an effective participation of the rural population and thus guarantee the full achievement of the environmental sustainability objectives of the project. The project also included specific monitoring and evaluation activities (forest exploitation and wildlife) designed to evaluate the achievement of its global environmental objectives that include maintenance of carbon sequestration capacity, CO_2 emission abatement and biodiversity conservation.

The project was implemented by the Energy Directorate (Ministry of Energy and Mines) and the National and Water and Forest Directorate of Senegal and was funded by various organizations to the tune of nearly US$20 million by various organizations that include Pays Bas (US$8 637 395.15), GEF (US$ 4 684 618. 60), IDA (US$ 5 135 725. 90) and Senegal Government (US$ 1 200 000).

The objective of PROGEDE is to contribute to the supply of household with domestic fuel on a regular and sustainable way, while ensuring environmental protection and by offering alternatives and options as well as comfort to end users

The criteria that guided the choice of case study targeted areas are the degree of introduction of improved stoves in the area; the dynamism of groups, the interest of population on improved stoves and their promotion; the importance and presence of development partners in the area, who worked on the topic and on the accessibility to the area.

The various types of improved stoves disseminated by the projects are presented in Table 3.6

Table 3.6 Types of improved stoves for Senegal.

Type of Stove	Description of the stove	Energy efficiency
Traditional stoves Three-stone hearth Malgache stove	Three-stone hearth, triangular device Stove made of metal	14% 19%
Ban ak suuf (Clay and sand)	This type uses firewood and was designed in 1985 in Senegal. It is made of clay and sand. Its lifetime is 1 year	24%
Improved three-stone hearths	This type of hearth using firewood is also made of clay. Its lifetime is 1 year.	22%
Sakhanal Mono	It is a stove made of metal. It was designed in Senegal by Centre for Studies and Research on Renewable Energies Cost: US$6.60 [17.43]	29%
Sakhanal Multi	The same design but can adapt to many cooking pans. Cost: US$6.60 [17.43]	24%
Sakhanal PPAM	The same design but can adapt to many cooking pans for family ceremonies	-

Diambar	This type is made of a sheet metal on which a piece of ceramic is applied. Its lifetime is 2 years. This model comprises many stoves (stoves for tea, from 2 to 4 kg, 4 to 7 kg	30 – 50%

Assessment of the case Study

The assessment focused on households, economically oriented women groups (GIE), small businesses (improved stove manufacturers, retailers) and on public services (health services) located in rural and peri-urban areas. In the peri-urban area in the Dakar region, enquiries have been conducted in the constituencies of Medina district, Thiaroye-Gare and Thiaroye-sur-Mer, Pikine Ouest, Sahm Notaire, Diacksao and Malika while in rural areas; they are conducted in Gandiaye, Dya and Thiomby constituencies in the region of Kaolack. The case study sample consisted of 80 peri-urban and rural households, 6 businesses, and 2 women groups (of which a federation composed of 51 GIE), and 3 public services.

The Causal chain on which data collection was based on is presented in Fig 3.8

The methods of data collection consisted of inquiries, focus group, observations and crosschecking. Enquiries allowed collecting data on economic, social and environmental impacts of improved stoves on households, businesses (restaurants, improved stoves manufacturers, the GIE and retailers) and health services. The enquiry tools used were questionnaires and interviews. Questionnaires were targeted at the rural and urban households using improved stoves and this method contributed to collecting quantitative data in each household interviewed.

Interviews were conducted with businesses (restaurants, GIE of improved stove manufacturers and retailers) health services and some established focus groups. Interviews facilitated data collection related to energy expenses, production and sale statistics, etc.

The focus group method was used for women groups to collect data on how women groups use and promote improved stoves, to augment data collected on households.

All the other data collected were supported by direct observations and data crosschecking.

The households were sampled from those using charcoal as the main fuel (5% of households) and equipped with Diambar improved stoves in urban and peri-urban households while in rural areas, the sample interviewed was from the households using firewood as the main fuel (93%)and possessing improved stoves.

A total of 35 urban and peri-urban households were interviewed distributed as follows: Medina 10 households; Thiaroye-Gare 07; Thiaroye-sur-Mer 06; Pikine Est 06; Sahm-Notaire 04 and Diacksao 02. The number of households interviewed in constituencies did not abide by defined standards but was done at random. A total of 45 rural households were interviewed and broken down as follows: Dya (25); Thiomby (15); Gandiaye (05)

The selection of sample for businesses was made from improved stove manufacturers restaurants, local grain processing units and retailers. Respondents of six (6) workshops units, 3 restaurants, 7 retailers and 1 local grain-processing unit were interviewed.

The selection of women groups in which focus groups have been organised was guided by the dynamism and activities of the GIE in the field of promotion and dissemination of improved stoves. The Federation Dioko and Ligguey from Malika with 52 women GIE, and the GIE Boko Diom from Dya comprising 3 women were selected for urban and rural areas respectively.

Impacts of improved stoves on the population health was measured in rural areas, since it is in these localities where smoke has evident adverse effects on the life of populations. The rural constituency of Gandiaye health centre was selected for the case study as it receives almost thirty (30) patients in a day.

It is realized that disseminating of improved stoves to rural areas and school canteens (rural educational system) has been low despite the potential provided by these market segments.

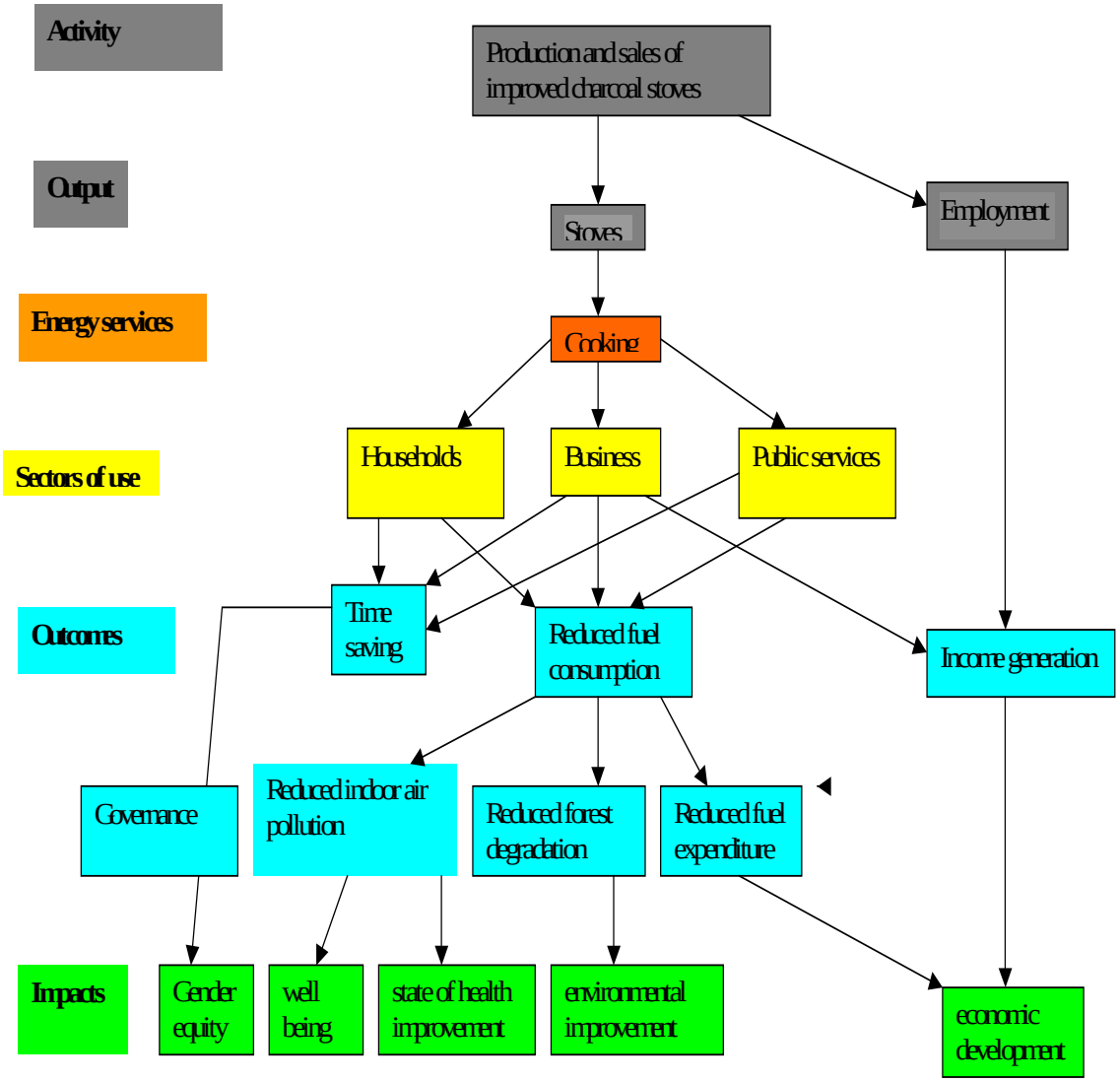


Fig 3.8 Causal Chain for the Improved Cook Stove- Senegal

Results of the case Study

During the enquiry, the performances of traditional stoves and improved stoves highlighted the real consumption of charcoal, the time for cooking the main meal and the frequency of renewal of kitchen stove and these have been translated into social, environmental and economic impacts of this energy intervention.

Households

The Malgache stove is the main traditional stove used by urban and peri-urban households in the region of Dakar. Its main fuel is charcoal and according to results of the enquiry, the average consumption of the Malgache stove is 2.5 kg of firewood per day/household. It corresponds to an energy expense of US$0.77

[2.04]. The average time for cooking the main meal was estimated at 2h50mn. Urban households used to renew their kitchen equipment (Malgache stove) every four months.

Table 3.7: Comparison of performances between Madagascan stoves and Diambar stoves.

Type of stove	Quantity of charcoal used per day (kg)	Daily expenses in charcoal (US$ [US$PPP])	Time for cooking the main meal	Frequency of replacement of the stove (month)
Madagascan stove	2.7	0.77 [2.04]	2h50mn	4
Diambar stove	1.3	0.38[1.00]	1h40mn	48
Amount saved	1.4	0.40[1.05]	1h10mn	

Considering Table 3.7 it is evident that urban and peri-urban households save at least 1.4 kg of charcoal per day when they change from the traditional to improved stove realizing a cost saving in fuelwood of US$0.40 [1.05] and US$6.42 [16.94] for cost of replacing traditional stoves..

Table 3.8 compares performances between traditional and improved stoves used by household in rural areas.

Table 3.8 Comparative performances between traditional and improved stoves in rural areas.

Types of stoves	Quantity of wood fuel used in a day per household (bundle of firewood)	Daily expense for buying wood fuel (US$ [US$PPP])	Time for cooking the main fuel	Frequency of replacement of stoves
Traditional stove	12	0.53[1.39]	2 hours	20
Improved stove	4	0.28[0.75]	1h 20mn	34
Saving	8	0.25[0.65]	40mn	-

Based on these case study results (Table 3.8), rural households that have shifted from using traditional stoves to using improved stoves save 8 bundles of firewood in a day, corresponding to US$0.25 [0.65] of fuel savings, and reduces the time of cooking the main meal from 2h 00 to 1h 20 minutes. Women who do the cooking thus gain 40 minutes.

Economically, improved stoves generate gains in energy expenses of fuel and costs of the renewing cooking stoves thus contributing largely to poverty reduction in both rural and urban community.

Saving of time has a positive social impact on women who save time in cooking (almost 1 hour) allowing them to participate in other domestic (e.g. devoting time to children and girls to education) activities, or group activities. The saving in fuelwood consumption also means reduced time and efforts to collect firewood. It was indicated that fuelwood collection has reduced by 2 or 3 trips per week, and women now collect firewood ounce a week saving 2h 30mn in every 48 hours. Hence, they have time for their literacy lessons and homework.

The reduction in charcoal and fuelwood consumption has been calculated to translate into protection and preservation of forests equivalent to 2.70 m^3 per urban household per year and 3.8 m^3 per rural household per year.. This means that using improved stoves may allow better management and exploitation of forest resources of the country.

Health

All of the people interviewed declared unanimously that traditional stoves had negative impacts on population health that include respiratory problems, skin disorder and sore eyes.

In urban and peri-urban areas about two-thirds (66%) of respondents were suffering from respiratory problems, 14.43% were suffering from skin disorder and 8.57% from sore eyes. The treatment with *Guiera senegalensis*, is the most current and costs about US$0.66 [1.74].

In rural area 50% of affected individuals suffer currently from respiratory problems, 34% from sore eyes and 16% from various other diseases. The average cost of treatment of smoke-related diseases is US$3.63 [9.59] according to the results of the inquiry. This figure is in harmony with those provided by the head of Gandiaye health centre that vary from US$1.89 [4.98] to US$3.79 [9.96].

According to the head of Gandiaye health centre there exists a correlation between the population health mostly women and children and the introduction of improved stoves in Gandiaye area. According to the statistics of smoke-related diseases acute respiratory problems are pre-dominant, pneumonia is rare but bronchitis is still persistent.

In Gandiaye, 869 patients, suffering smoke related health troubles were treated, which is 13% of the people diagnosed in 2005. In Malika, this proportion is around 16%: 813 out of 5056 medical diagnostics in 2005.

The authorities of the health centre have noticed over this decade, a drop by 50% of smoke-related diseases in Gandiaye and 10% in Malika. The significant drop of smoke-related diseases cannot be attributed entirely to the introduction of improved stoves; however it coincides with the interventions of many projects or services intervening in the dissemination and promotion of improved stoves such as PAGERNA/GTZ, CERP, etc.

Businesses

In the three restaurants where the inquiry was made that mainly use improved charcoal stoves, charcoal consumption has reduced from 5.5 kg per day with traditional stoves to 2.8 kg with improved stoves resulting in a saving of 2.7 kg per day which is equivalent to a saving of US$0.66 [1.74] or US$195.62 [516.44] per year. The savings are reinvested in the improvement of the premises and modernisation of equipment to attract the costumers. At the same time improved stoves contributed to the reduction of cooking time in restaurants from 3h06 with the Madagascan stove to 2 hours with a Diambar stove. With regard to these results, inquiries in restaurants confirm those obtained in households of reduction of charcoal consumption, cooking time, increase of incomes due to the reduction of smoke-related diseases.

In the case of the GIE that manufactures improved stoves, the inquiry revealed that most of the businesses' workshops make at least 61 improved stoves per month and sell 54 and most of improved stoves are ordered before they are manufactured. The main improved stoves are the Diambar stoves of 15 kg, 10 kg, 3 to 5 kg, the Diambar stoves for firewood; the Diambar stove for tea and the Diambar

Sakhanal 7 kg and others. The manufacture of stoves brings income of the order of US$2.83 [7.47] and US$22.64 [59.77] depending on the type, capacity and quality of the metallic sheet and clay. Each manufacturing unit has 2 permanent staff and 4 apprentices, the salary of which is about US$59.06 [155.91] per month and US$21.32 [56.29] per month respectively. This indicates that manufacturing of stoves created income and also employment in the country.

The retailers, who are the indirect employees in the chain of production and supplies of improved stoves sell an average of 12 improved stoves per month each earning US$24.74 [65.30] per month, which is comparable to the salary of an apprentice.

The local grain processing unit comprising of the women Federation" Dioko and Ligguey" of Malika, markets by-products of grains. Thiacry and Sankhal employs 27 women with 4 improved stoves of 15 kg for preparing the couscous using two charcoal improved stoves and two firewood ICS. The results of the inquiry reveal that the reduction of energy expenses for each operation has moved from US$5.66 [14.94] to US$2.36 [6.23], saving US$3.30 [8.72] (or US$26.42 [69.74] per month). The use of improved stove has also reduced time for preparing couscous from 3 hours with traditional stoves to 2 hours with improved stoves thus giving the women additional time to participate in the Federation activities or have leisure.

The summary showing the development impacts and the link to MDGs is presented in Table 3.9.

3.9 Summary for development impacts of the ICS and the link to MDGs for Senegal

Intervention	Technology	Sector	Proposed link to MDG in Causal Link-here given as impacts	Case Study findings & link to MDG	Substantiation	Remarks
PROGEDE	Improved Cook stove	Household	Economic development	Saved income MDG1	US$0.40 [1.05] per day for fuel; US$6.42 [16.94] on stove replacement costs	
			Environmental Improvement	Forest Resource management MDG7	2.7 m^3 of charcoal per urban-peri-urban household per year by using ICS; 3.9 m^3 of fuelwood saved per rural household	
			State of Health Improvement	Reduced smoke related diseases MDG4 & 5	By 50% in this decade & each treatment estimated at US$2.83 [7.47]-US$3.77 [9.96]	
			Well being	Reduced burden MDG3	Saved cooking time of about 1 hour per main meal	
			Gender equity		Reduced fuelwood collection time by 2.5 hrs in every 48 hours	
		Business	Economic development	Poverty Alleviation MDG1		
		Restaurants		Saved income MDG1	US$0.66 [1.74] saved per day (US$195.62	

					[516.44] per yr) per restaurant	
		Stove manufactures		Created income MDG1	- US$2.83 [7.47]- US$3.77 [9.96] made per stove made	
				Created employment MDG1	2 permanent and 4 technicians employed	Income of permanent US$59.06 [185.91] and technician US$21.32 [56.29] respectively
		Stove retailers		Created income MDG1	US$24.74 [65.30] per month	
		Community grain processing unit		Saved income-MDG1	On reduced energy expenses (US$26.42 [69.74] /month)	
				Reduced women burden MDG3	Saved time of 1 hour per main meal cooking with improved stove	

Stakeholder Response to the Case study and performance of the AF

There was a general satisfaction of stakeholders with DEA's approach and stakeholders have expressed some needs that include:

- Stakeholders' training on the other themes developed with regard to DEA's methodology (renewable energy, rural electrification, motive power, etc.)
- To avail the AF tool for use by local decision makers through the multisectoral group
- To avail the AF tool for monitoring and evaluation process and there is willingness to try it in rural electrification projects in the Saloum islands
- To train decision-makers in the macro-economic analysis (impact on GDP, energy security, etc.) using the AF.

Stakeholder wanted the flowing indicators to be highlighted in the assessment or monitoring and evaluation process

- Indicators that have strategic interest in women to assess the impact on women's social condition and confirm if the saving of time resulting from the use of improved cook stoves mean that it helps ensure that women gain social positions.
- Good governance: this indicator could help figure out the number of women who are effectively involved in decision making bodies in their communities. In this regard, this indicator should be listed among the 'saving of time' variables in order to assess the use made of the saved time.
- Reduction of some conflicts: can also be sought through the rational use of some forms of energy such as household fuel in relation to land ownership and other land issues as this indicator could have indications of an impact on peace and security.

Stakeholders wanted the inclusion of hospitals, fire stations, and prisons, barracks that use loads of fuelwood in the assessment of impacts on public services sector. In the case of enterprises, they wanted assessment of pottery industry in terms of employment generation added.

The stakeholders realize that until monitoring is introduced for projects from their initiation, attribution of impacts will still be problematic since energy is a cross-sectoral issue. Meanwhile it suffices to refer to baselines of information that is known

3.2.5 Tanzania Case Study 1 - Solar/Wind Powered Small Scale Irrigation Pumps

Background

The case study for Tanzania was on the wind and solar powered small scale irrigation pumps that were installed in 2001 for villagers living on the shores of Lake Victoria. The project was financed through UNDP/ GEF Small Grants Programme as part of the 8 small-scale irrigation projects that were implemented in the Lake Zone (Ukerewe, Magu, Bunda and Musoma), to address food poverty as well as income poverty. The case study concentrated on the wind and solar powered water pumps in Ukerewe District, Mwanza Region, namely the Nakatunguru wind pump and the Namagubo Solar pump.

An executive committee comprised of the chairperson, secretary, treasurer and three members managed the two projects in Ukerewe. The United Nations Volunteer Irrigation Engineer who is based at Bunda and assisted by District Irrigation Technicians from each participating district coordinated implementation. Projects funds were disbursed directly to the beneficiary groups and the group treasurers were trained to increase their accounting skills. For control purposes, funds were not drawn unless minutes were provided to show that the respective Project Committee endorsed the transaction being presented and cheques prepared by the groups were counter-signed by an authorized officer at the District Council

The main objective of the projects was to promote wide adoption of renewable energy technologies specifically wind energy and solar power for water pumping and irrigation farming for villages that are located adjacent to Lake Victoria. It was argued that communities continued to suffer from food shortages due to deficient rain pattern while there was plenty of water in Lake Victoria.

From this premise the secondary objectives were:

- To increase production of food crops in order to reduce and eventually eradicate food poverty to Lake adjacent communities;
- To grow high value crops e.g. tomatoes, onions, sweet pepper etc., all year round in order to raise incomes with a view to addressing income poverty;
- That the wide use of renewable energy technologies would result in reduction of greenhouse gas emissions, thus positively impacting on the global atmosphere.

Assessment of the Case Study

The assessment was made for the wind powered small-scale irrigation scheme at Nakatunguru and the Nakatunguru farmers came together as a group in the year 2000 with 6 members and 3 acres. To date the group has grown to 36 members owning 50 acres.

The economy of the Ukerewe district is mainly based on fishing and agriculture, however, agricultural activities are dominant. The district has favourable conditions for a wide range of crops. The crops that can be grown include cassava, sweet potatoes, paddy, banana, legumes, maize, sorghum, groundnuts, green vegetables, citrus, pineapples, bambaranuts, mangoes, coffee, palm, cocoa, sisal, cotton, simsim and sunflower. The main food crop is cassava followed by sweet potatoes. Cassava is now used as cash crop and at the same time used as the main staple food. The neighbouring districts depend on Ukerewe for

Cassava. The district also has a big potential for fruit production. The common fruits produced include: citrus, orange, pineapple and mangoes.

The farming groups in the two villages under consideration received funding from UNDP/GEF Small Grants Programme in October 15, 2001. During that time the group had already grown to 12 members plus 8 who had applied for membership. The total project cost was US$34,622.33 [72,360.66] while group's contribution was US$1528.25 [3194] and the grant requested was US$32,415.20 [67,747.78]. The Project was expected to expire by December 31, 2003.

A wind and gravity irrigation system was recommended since wind is not available in constant magnitudes and direction. A 20 ft Kijito windmill (from BHL Thika Kenya) was installed close to the Lakeshores whereby water was being pumped through a mains pipeline to a 120,000 litres storage tank from where water flowed by gravity to gardens and farms.

Due to non-completion of project activities (works that could not be finished due to changes in the price level and procurement and delivery problems), consolidation funds amounting to US$3000.00 [6270.00] were provided to this project in 2005. Other intended purposes for consolidation funds were extension of main water inlet, provision of domestic water supply lines so that the project can cater for both irrigation farming and domestic water supply; and farmers' re-training in agronomy, marketing and finance management.

The Solar powered small-scale irrigation Scheme is located at Namagubo village, and is owned by Namagubo Farmers that came together as a group in 2000 with 5 members and 5 acres of land. To date the group has grown to 60 family members owning 50 acres of land. This project received funding from UNDP/GEF Small Grants Programme in October 15, 2001 when the group was already grown to 14 members. The total project cost was US$35,379.70 [73,943.58] while group's contribution was US$1640.00 [3427.60] and the grant requested was US$33,739.70 [70,515.98]. The Project was expected to expire by December 31, 2003.

A demonstrational solar and gravity irrigation system was recommended and installed. The installed capacity is 1920Wp with 16 pieces module KYOCERA KC 120-1 manufactured by Kyocera Corporation of Japan. The system was installed close to the Lakeshores whereby water was being pumped and stored in an elevated tank during the day (solar pumps can only operate during the daylight part of the day). Water was pumped through a mains pipeline to a 100,000 litres storage tank from where water flowed by gravity to gardens and farms.

Construction work for wells, canals and reserve tank was completed in 2003 but installation of Solar panels could not be done before September 2004 due to delayed shipment from Japan.

Consolidation funds amounting to US$5000 [10,450.00] were provided to this project in 2005 for extension of inlet main, provision for domestic water supply, extension of main canal to increase command area; and farmers re-training in agronomy, marketing and finance management.

Three capacity building trainings were provided to the Namagubo group:

- Some of the group members attended the Tengeru horticultural training programme (this was conducted twice);
- Some group members attended training on how to manage and maintain an irrigation facility (ditches, wind/ solar facility);

- Leadership training on how to lead and enhance group cohesion, how to conduct group meetings, writing of minutes, the meaning of quorum and change of leadership.

The causal chain in Fig 3.9 guided the data collection for assessing impacts of the two project schemes. Both primary and secondary sources of data were collected.

The secondary data included a review of available documentations and studies were relevant to this study. The documents reviewed included the following:

- GEF Small Grants Programmes, which were funded between 2001 and 2003,
- The Ukerewe District Profile,
- Development and Energy in Africa: WP 4.2.4 – Policy Makers' Needs, Synthesis Report,
- Monitoring and Evaluation for Energy and Development – Template for Technology Specific Modules and the Sustainable Pathways to Attain the Millennium Development Goals –
- Assessing the Key Role of Water, Energy and Sanitation.

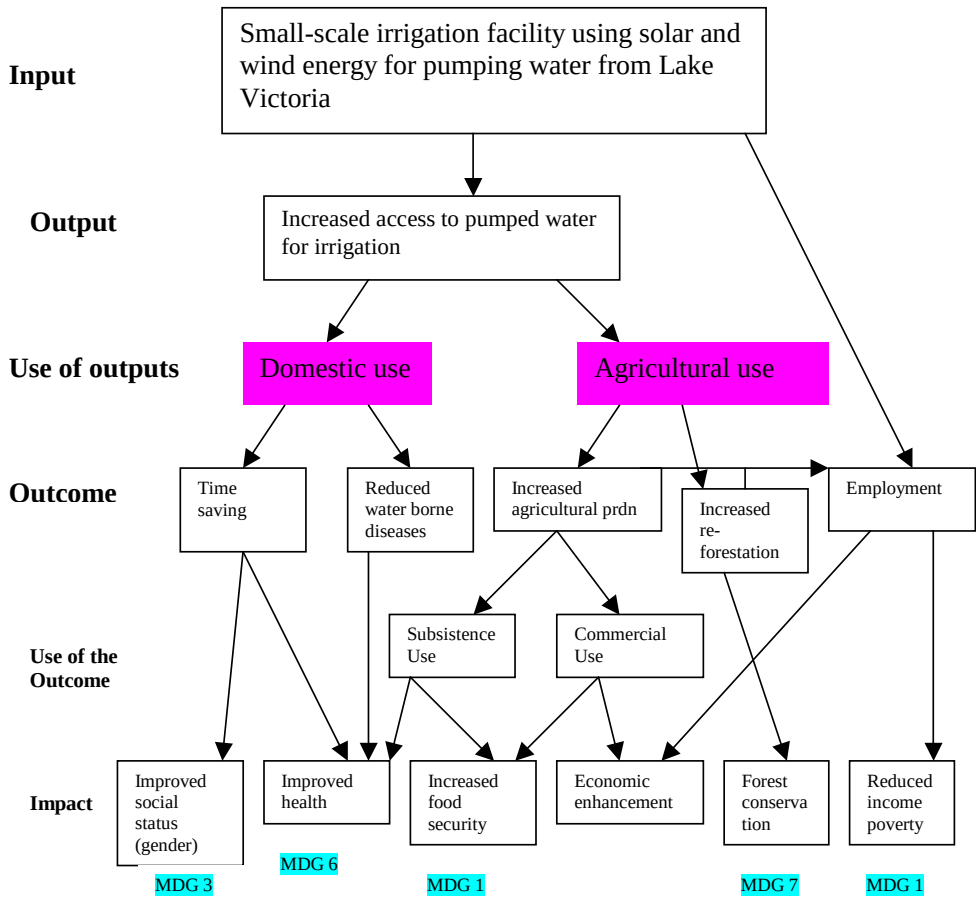


Fig 3.9 Causal Chain for the Wind and solar powered water pumps

Participatory data collection tools and structured questionnaires were used to collect primary data for the study. At least 46 men and women respondents were contacted and interviewed using structured questionnaires, focus group discussions or workshop-setting discussions.

All farmers were informed and interviews were conducted with those who showed up. The interviewees were 11 farmers (4 women, 7 men) from Nakatunguru Wind powered irrigation system and 12 farmers (4 women, 8 men) from Namagubo Solar powered irrigation system. Due to the small number of farmers participating in these two projects, the researchers wished to interview all farmers but time did not permit. Interviews were conducted at times which caused least disruption to farmers' daily routines and that took place near their gardens.

Sixteen (16) projects committee members (Ndakatunguru 9 and Namagubo 7) were interviewed at a Focused Group Discussion setup.

Six (6) officials from the Ukerewe District Council were consulted in workshop setting where the researchers presented findings of the study and gathered their views and comments. The officials were District Executive Director, District Planning Officer, District Agricultural and Livestock Development Officer, District Crop and Irrigation Officer, District Livestock Development Officer and Ward Extension Officer.

One (1) key informant from the UNDP/GEF Small grants Programme was consulted and provided insights about the two GEF funded projects.

Two district council's officials (District Crop & Irrigation Officer and Ward Extension Officer) acted as key informants and accompanied all visits to interview farmers and provided background information on the two projects.

The analysis of responses from the respondents was done using just a simple statistical method using Ms Access software.

The questionnaires were designed to test the intended outcomes and impacts of the two projects in order to help test the Preliminary Assessment Framework (PAF). The hypothesized development impacts were to be tested against reduced income poverty, reduced hunger, improved social relations, gender and sustainable environment.

Results of the case Study

Some of the Nakatunguru beneficiaries accessed pumped water for a period of three months, between December 2002 and January 2003. The interviews conducted with beneficiaries revealed that access to water was increased during the three months when they were getting pumped water. Though it was difficult to quantify, people were able to get enough water to fill their fields and could wait for two days before they needed water again. This reduced the drudgery of carrying water from the lake to the fields almost 250m away. It was assumed that women were able to attend to other activities and children had more time for study and leisure. Also access to enough water made the farms more conducive for planting crops like paddy and all other kinds of vegetables.

Although the projects have not performed as was originally planned, there are salient benefits that are the results of these projects. The projects have improved social relationship amongst the members. Members are now like one family, although there is no access to pumped water, communities have continued to irrigate each others land and this has increased unity amongst the members.

Apart from the social relation, the projects have trained some group members' better methods of agriculture, horticulture, better management of irrigation schemes and leadership skills.

While the water was available, the number of beneficiaries and acreage under production increased from 6 farmers and 3 acres in year 2000 to 36 farmers and 50 acres in year 2006 (Nakatunguru), and from 5 farmers and 5 acres in year 2000 to 60 farmers and 50 acres in year 2006 (Namagubo). The land under irrigation has been sustained although the water is now being provided the way farmers used to do prior to the project.

The case study has therefore been limited in exposing its development impacts since the activities stopped soon after the project was implemented. This emphasizes the importance of project planning that takes other important inputs into account to achieve sustainable development benefits.

The Summary showing the development impacts realized in the case study and their link to MDGs is in Table 3.10

Table 3.10 Summary linking development impacts and MDGs for the Renewable Energy Project of Tanzania

intervention	Technology	Sector	Proposed link to MDG in Causal Link- here given as impacts	Case Study findings & link to MDG	Substantiation	Remarks
Renewable Energy	Wind Powered Small Scale irrigation pump	Domestic	Improved health	Reduced burden of community MDG3	Avoided carrying water for 250 m from the lake Victoria	True when the pump was working for the 3 months
			Improved social status (gender)	Improved social relationships MDG3	Cooperative water collection and irrigation of each ones land.	
		agriculture	Reduced income poverty			
			Forest conservation			
			Economic enhancement	Education on agriculture and horticulture MDG2	Training of farmers	
			Increased food security	Increased production MDG1	Increased land of production from 3 acres to 50 acres	Size of land under cultivation has been maintained
					Additional crops planted	True when the pump was working for the 3 months
	Solar Powered Small Scale irrigation pump	Domestic	Improved health	Reduced burden of community MDG3	Avoided carrying water for 250 m from the lake Victoria	True when the pump was working for the 3 months
			Improved social status (gender)			

		agriculture	Reduced income poverty			
			Forest conservation			
			Economic enhancement			
			Increased food security	Increased production MDG1	Increased land of production from 5 acres to 50 acres	Size of land under cultivation has been maintained
					Additional crops planted	True when the pump was working for the 3 months
			Improved health			

Stakeholder Responses

Stakeholders would like a mechanism that will allow the AF to reach the policy makers both at national and local levels. To this effect it was recommended that a guiding manual be developed on how to use the AF and build capacity at both national and district level to use it as a monitoring and evaluation tool.

In refining the AF, the stakeholders recommended the following:

- Need to conduct baseline survey at the onset of the project in order to come up with appropriate indicators and reference data for monitoring and evaluating change,
- Need to involve key stakeholders in all stages of project cycle (planning to evaluation) and in the development of indicators that reflect their development objectives. The use of AF should create a feedback loop into the policy/project cycle
- Need to involve policy makers in all stages of impact assessment and ensure findings/information conform to their needs
- The Assessment Framework should be simple and easy to use,
- The AF should be able hypothesize general indicators and specific indicators should come from specific cases by users,
- Need to document the case studies and publish results of the projects using DEA assessment framework
- Use of the AF to provide inputs to monitoring and evaluation process of the National Strategy for Growth and Poverty Reduction Programme and sector policies
- Find the possibility of forming the database for storing information from different sectors and for feedback into national policies
- Packaging the information from AF and make it accessible by all stakeholders,
- Other key stakeholders such as the MRALG should be represented in the next workshops
- Conduct practical training for ministry M& E staff
- There is necessity for conducting further study in order to find out a way for incorporating AF in the impact assessment and continue to modify the framework to broaden its application
- After its development, the AF should be applied in the energy related interventions and find the possibility of introducing it to other sectors' projects

3.2.6 Tanzania Case Study 2 - Improved Cook Stove

Background

This study evaluated the impacts of an improved cook stove (ICS) project run 2 years previously in Tanzania. The project was part of the 5-year UNDP East African Cross Border Biodiversity Project (CBBP) that was initiated at four sites in Kenya, Uganda and Tanzania in 1998. The 12.5 million US $ GEF funded project sought to enhance co-operation between government agencies and communities to reduce forest biodiversity loss. Project activities included resource-user surveys, bird and butterfly surveys and support for initiatives encouraging tree planting, efficient stoves and bio-digesters.

In Tanzania, the project was aimed at 3 areas of considerable biodiversity, with target villages being selected on the basis of their proximity to the forest and proven dependency on the forest for fuel. To scale up CBBP's results, Developing Sustainable Rural Energy Strategies at District Level (DSRESDL) was launched in 2002 with a budget of US $100 000. In 2003, traditional Energy Development and Environment Organization (TaTEDO) was asked to assume control of the project in Tanzania. TaTEDO received $57 000 from United Nations Development Programme (UNDP) via the National Environment Management Council to carry out project activities for the remaining 8 months of the project, i.e. implementing technologies introduced by CBBP. Focusing in Bukoba, Monduli and Same districts, the project facilitated ICS introduction (focus of this study), establishment of tree nurseries, promotion of biodiesel lamps and stoves and construction of a biogas plant. The project was implemented in three villages in each district, and village selection was based on villagers' willingness to participate and village accessibility.

Assessment of the Case Study

The ICS component of the DSRESDL project was chosen for study. The impact assessment was undertaken in the villages of Sinon Ngarash village and Mhero and selection was based on advice of government officials. Sinon Ngarash, with between 450 and 560 households is situated 2 km from the district centre, Monduli. The main ethnic groups are Masaai, Wameru and Wachagga, primarily engaging in agriculture (maize, beans, wheat) and herding (cattle, goats, donkeys, sheep). The village of Mhero with a population of 1,727 in 350 households lies in the Pare Mountains 45 km from the district centre, Same. The Wapare, the main ethnic group, engage in agriculture (maize, beans, potatoes, coffee, vegetables) and herding (cattle, goats, sheep, pigs)).

The evaluation provided the basis for discussion of implications for future ICS projects and impact assessment more generally. The AF of Development and Energy in Africa (DEA) was primarily used to address 'what' impacts resulted. This assessment was supplemented by the modified Institutional Analysis and Development (IAD) framework, which was applied to investigate why the impacts identified by the DEA framework resulted.

The improved cook stoves (ICS) were considered to have the flowing characteristics:

- A chimney so that smoke leaves kitchen
- An enclosed fire that would conserve heat
- A pot holder design to maximize heat transfer from fire to pot
- Dampers to regulate air flow
- A Grate so that alternative fuels may be used, and ash can be removed

- A metal casing to lengthen the stove's life
- Multi-pot systems so that several pots may be heated simultaneously

The consideration in promoting ICS is that access to modern energy is and will be beyond the means of much of the world's population therefore ICS have a role in ensuring efficient and safe use of biomass fuels. Fig 3.10 presents the causal chain that was developed to guide the assessment of development impacts of the ICS intervention in Tanzania.

In conducting the research, a range of methods was employed to triangulate and thereby validate the information obtained (Adams *et al.*, 2000; IFAD, 2002). Primarily qualitative methods were adopted but where possible, quantitative data was gathered. Methods included a literature review, in-depth semi-structured interviews with key officials in the energy/ICS sector in Dar es Salaam and several informal discussions with staff running Tanzanian ICS projects. In addition, two weeks were spent at each village site where in-depth semi-structured interviews were conducted with villagers and government officials at district, village and sub-village level. A focus group was run with each village's Village Environmental Committee (VEC) and key informants (2 in each village) facilitating the village visits. Extensive observation was made of each village and its associated activities.

The literature review involved a wide range of academic literature, NGO publications and reports and Tanzanian government reports relating to ICS projects. Literature on the Tanzanian energy situation, impact analysis, the DEA project and institutional analysis was reviewed. The information analysed provided a background to the study, facilitating implementation of the DEA's AF and modified IAD frameworks and enabling interview development.

The study's interviews were also developed and tested with key informants. All interviews, based on but not restricted to a list of guiding questions, were conducted aimed to investigate perceptions about the project's activities and impacts and to gather officials' opinions on factors affecting impacts. The village chairman was the first to be interviewed in each village, the opportunity being used to obtain permission to conduct the study. Some technicians trained by the project were interviewed to investigate their training, and their continued involvement with ICS construction and factors affecting this involvement.

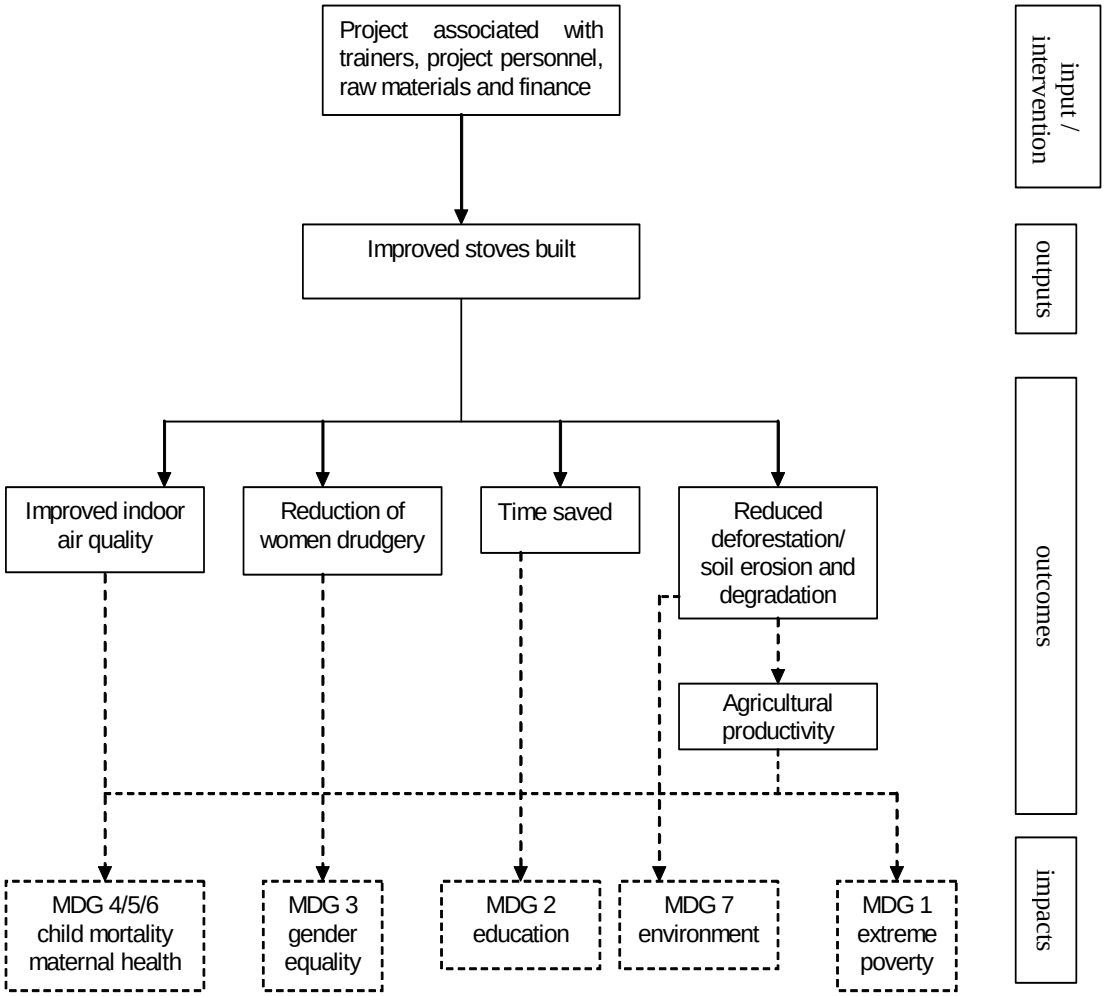


Fig 3.10 The causal chain for Improved Cook Stove Case Study in Tanzania.

Villagers were interviewed to investigate their perceptions of the ICS and factors influencing them and their participation in village life. The interviewees were predominantly female, as men are rarely involved in cooking or gathering wood. Three categories of villagers were interviewed namely ICS users, ICS ex users and ICS non users and the samples covered in the impact assessment are provided in the Table 3.11 below.

Table 3.11 Samples of village respondents for the ICS

	Sinon Ngarash,	Mhero
ICS user	18	33
ICS ex user	13	7
ICS non user	3	6

Interviews were transcribed into English, producing 250 typed pages of manuscript, and were subsequently sorted and coded using the programme N*VIVO, which systematically analyses qualitative data (Durian, 2002) and reduces the tendency for data mining, i.e. using data to present evidence sought by the researcher (White, 2005). The interview material was coded using headings derived from the DEA and modified IAD frameworks, enabling comparison and connection of themes. Where possible information obtained from interviews was presented in graphical form.

Results of the case Study

The impact analysis presented results for the full four-level hierarchy of the DEA AF. Inputs were mostly the human resource (institutionally provided) input, the material testing, training of technicians, meetings and workshops to raise awareness and the building of the stoves. The outputs were mostly in relation to the ICS use, trainers trained and awareness raised. Outcomes were related to income and employment generation, reduction in fuel consumption, time saving, health and safety, reduced forest degradation and introduction of any byelaws governing forest resource management.

The results for both villages were evaluated to determine the likelihood of the hypothesized impacts, addressing the research question "what were the impacts of the project?" The impact assessment results presented here are for outcomes and impacts as inputs and outputs were similar in both villages covered by the project.

In Sinon Ngarash

With regard to income and employment generation, the money earned by technicians during the project bought "clothes for me and shoes for the children". However current stove related income is only sufficient for items such as soap and salt as few stoves are being built and labour charges are dependent on agreement between the technician and the owner. The average amount isUS$1.60 [US$PPP3.34] (£1) or an in-kind equivalent e.g. maize or beans (interviews. This reflects that stove making has not improved incomes nor sustained the incentive provided by the project.

For assessing reduction of fuel consumption, the number of trips made to collect woodfuel before and after ICS introduction was used as a proxy. The proxy was affected by the varying numbers of people that went to collect wood as the volume of wood carried depended on a person's health, age and strength. However the number of trips appeared to have fallen considerably, suggesting that ICS reduced woodfuel consumption, as was perceived by the users.

For Time saving, it was estimated based on some ICS user responses that the ICS reduce time spent collecting woodfuel in a household by an average of 4.8 hours a week. Instead of fetching woodfuel women did housework, fetched water or farmed. The involvement of women in chores is not eliminated

but is shifted to other activities; in essence they may not be relieved of the burden as a result of time saved from collecting fuelwood.

For Health and safety, *o*nly 2 ICS in Sinon Ngarash had chimneys, implying little reduction in indoor air pollution as the chimney, rather than changes in combustion efficiency is responsible for reducing the indoor air pollution. Safety benefits of ICS were thus not recognized and data regarding health effects was unavailable.

With regard to reduced forest degradation, only 2 of the 34 users/ex-users/non-users interviewed related ICS adoption to reductions in environmental degradation. All ICS stove technicians, Village Environmental Committee (VEC) members and village and district government officials correlated adoption with less tree cutting. Despite officials' comments, and even if statistics demonstrating changes in forest area had been available, attributing change to the ICS project in Sinon Ngarash would have been virtually impossible given the relatively small proportion of ICS users in the village.

Introduction of by-laws After the project's initiation, and attempting to ensure it's sustainability, village ICS by-laws had been developed, building on project-generated ICS awareness. The laws, approved but awaiting implementation required each household to use an ICS and restricted households' access to the forest.

Mhero

With regard to income and employment generation, technicians charged from "a cup of tea" to US$3.20 [US$PPP6.69] to build a stove but few were being built, so no significant or regular income was generated, rather occasional money for buying small essentials.

For reduction of fuel consumption, ICS was perceived to reduce woodfuel consumption but calculating changes in the proxy, woodfuel collection proved difficult, as wood for the majority was readily available in this village. Several interviewees were asked about the benefits of lowering stove woodfuel consumption, but explanations were limited. A stove water-boiling test was undertaken and variation in stove design generated variation in results as different stoves raised the pan above the fire to differing degrees. The test however suggests that ICS can reduce wood consumption.

For reduction of indoor air pollution, reduced smoke was noted as a benefit of the ICS and 2 older women commented on eyesight improvements. However 10 of the 34 ICS observed had broken or half built chimneys and even ICS with complete chimneys were observed to produce considerable amounts of smoke due to poor maintenance or low quality of ICS construction.

Statistics from Mhero's dispensary and an interview with a local nurse indicated that effects of other factors might complicate attribution of results obtained. For example, the nurse attributed the considerable increase in Acute Respiratory Infection in 2005 to a very dry, dusty period rather than to stove smokes. There were very few burns as the majority of the population use a form of improved stove, and only a few cook with the 3 stone fire

With regard to reduced forest degradation, many noted reduced wood consumption as a benefit of the ICS but no one, including village leadership, linked ICS usage with reduced forest degradation. Forest degradation is not significant in Mhero as trees are numerous, wood is often collected from family shambas and tree-planting programmes exist.

Estimating time saved in woodfuel collection by ICS adoption was unfeasible: some did not comment on changes in woodfuel consumption with the ICS while many others did not note changes in trip frequency The few interviewees who recognized a time saving used the time to do housework, to rest or to work in the shamba or vegetable garden.

Summary Development impacts analysis

The analysis presents assessed development impacts resulting from the ICS project in terms of Poverty Reduction, Health, Education, Gender and the Environment as these aspects of development also have a link with the Millennium Development Goals.

Poverty Reduction: little/no change

Income generated by stove technicians in both villages was negligible: the income generated during the ICS project could not be sustained after the project ended. There is the notion that ICS-users may, if time is saved in woodfuel collection, have more opportunities to earn an income (Barnes et al, 1993). This assumption assumes that income-earning opportunities are available and that 'saved' time is used for such activities. In both villages, evidence for these was limited observation. Although incomes may have increased for the ICS-users who spent more time tending a vegetable garden (Mhero) or working in the fields (Mhero and Sinon Ngarash), there were few of them, and agricultural output is dependant on factors beyond solely time invested, including input availability and rainfall.

Health: little/no change

ICS can reduce the incidence of burns and pans being knocked over (GTZ, 2004) however, stove users in Sinon Ngarash did not comment on the improved safety aspects of the ICS, possibly they did not find the 3 stone stove as unsafe as is documented. In Mhero, burns were infrequent, likely due to the widespread adoption of improved stoves: either the traditional Usambara stove or the project ICS. Lack of chimneys or their poor quality reduced potential improvements in indoor air pollution: in Sinon Ngarash tin for the chimney was costly and therefore not purchased; in Mhero many chimneys were unfinished or poorly maintained.

Education

The time saved in woodfuel collection following ICS adoption can lead to higher levels of education for children, especially girls (GTZ, 2004), however evidence of this did not emerge from the study. It was witnessed that on completing school for the day, children returned home to work: if not to collect woodfuel then, for example, to cook or collect water.

Gender

The study found no perceptible change in gender relations or women's status but this is consistent with other findings, which suggest that ICS introduction itself, while reducing women's workload, does not fundamentally alter women's role (Oparaocha, 2005).

Environment

In Sinon Ngarash, ICS usage appeared to reduce woodfuel collection however, as only 11-13% of households were ICS-users, changes in e.g. forest cover were likely negligible. A more permanent contribution was the awareness raised which resulted in by-laws –their impact dependent on their implementation. In Mhero, the declared decrease in wood consumption would imply fewer trees were being cut as woodfuel. Although deforestation was not perceived to be an issue, reduced tree felling could contribute to the sustainability of family woodlots.

The Summary showing the link between development impacts identified in this ICS intervention and the MDGs is presented in Table 3.12.

Table 3.12 Summary of development impacts and the link with MDGs for the ICS intervention of Tanzania.

Intervention	Technology	Sector	Proposed link to MDG in Causal Link- here given as impacts	Case Study findings & link to MDG	Substantiation	Remarks
CBB P/DS RES DL	Improved Cook stove	Sinon Ngarash	Extreme Poverty	Income minimal MDG1	US$1.60 [US$PPP3.34] or in kind	Less than the project incentive technicians got
		Household				
			Environment	Reduced wood fuel consumption MDG7	Perceived by ICS users	Small effect due to small proportion of ICS users
				Creation of bye-laws MDG7	For forest resource management	Effect will be dependent on implementation
			Education	Reduced burden on community MDG 3	4.8 hours per week from wood fuel collection	Time spent on other chores not studying/literacy classes
			Gender Equality	Reduced burden on collection of fuelwood MDG3	Reduced trips	Complex to arrive at reduced fuelwood consumption through trip numbers as other factors of collection creep in.
			Child mortality & Maternal Health	Health effects not realized MDG 4 & 5	No chimneys and significant smoke from ICS with chimney	Observation
		Mhero	Extreme Poverty	Income minimal MDG1	US$3.20 [6.69] or in kind	Less than the project incentive technicians got & irregular

		household	Environment	Reduced wood fuel consumption MDG 3 & 7	Partially proven by water boiling test	ICS time was less than traditional stoves
				Reduced tree felling	Reported	Can contribute to sustainability of family woodlots.
			Education	Level of Reduced Burden unknown MDG3	Time saved could not be verified	Time spent in other chores not studying/literacy classes
			Gender Equality	Women role unchanged by ICS MDG 3		Involved in other household roles
			Child mortality & Maternal Health	Limited impact on diseases MDG 4 & 5	Eyesight improvements for few	
					Still considerable amount of smoke from ICS	

3.2.7 Zambia Case Study - Solar PV ESCOs

Background

The case study for Zambia sought to assess the impact of energy service provided by ESCOs to different sectors that are domestic, health, education and business. The large-scale introduction of solar PV in Zambia was done in the Eastern province of Zambia towards the end of the 1990's when the Energy Service Company (ESCO) project was started by the Department of Energy of the Republic of Zambia. The ownership and insurance of the Solar Home Systems is still with the government of the Republic of Zambia through the Department of Energy.

The project received funding from the Swedish International Development Agency (SIDA). This rural energy services companies project was phase I of SIDA funding and was initiated in 1998. The focus of the ESCO project was to identify the conditions for solar photovoltaic systems in rural areas, to locate prospective entrepreneurs and to help them get started.

The first ESCOs commenced operations by 2000 with at least 100 solar systems. Market and socio economic surveys indicated that the selected towns in eastern province, although not serviced by national grid electricity but were comparatively wealthier communities to afford modern energy services due to their strong agricultural base.

Assessment of the Case Study

The assessment was carried out for Chipata Energy Services Company (CHESCO) and **N**yimba Energy Service Company (NESCO).

CHESCO is located in Chipata town and the company started operations in the year 2000 with the view of supplying solar home systems. The current workforce of the company is 4 persons, consisting of one director, one administrative officer and two technicians

Since the establishment of CHESCO, seven persons, 3 as accountants and the rest as technicians have been trained. The technicians have been trained at the University of Zambia in skills such as servicing, sizing, installation, troubleshooting and repairs.

Initially, the firm started with 150 solar PV home systems but at the time of the questionnaire study 138 were working. Out of their current client number 50% are civil servants, 30% farmers and 20 % business people. Most of the civil servants are also involved in farming activities, which help them supplement the monthly cost of solar home systems charged by CHESCO. At the moment less than 10 people have withdrawn from CHESCO due to several reasons that include:

- Acquisition of their own PV systems
- Bereavement of the breadwinner
- Inability to afford
- One of the clients has connected to the grid when it reached the village

The annual income of CHESCO varies and is so much affected by tobacco and maize yields, and market hence the income of most clients is not steady because it is agriculture based. About 80% of the maintenance costs of solar home systems are borne by the clients. CHESCO is currently charging its clients an amount of US$16.00 [35.51] monthly. The companies monthly wage bill is US$615.26 [1365.88]. CHESCO has arranged that the farmers use the PVs and pay later with interest after harvest and selling of farm their produce. The interest ranges from 10% to 20% of the amount accrued.

In order to safeguard the PV equipment and lengthen the life of the battery CHESCO has put a directive to its clients not to use inverters on the PV home systems. Any flouting of the directive is met with a penalty of US$36.92 [81.95].

NESCO is in Nyimba along the Great East Road between Lusaka and Chipata about 200km from Lusaka. The grid electricity has just been extended to the town. The present set up is that the grid passes through the town of Nyimba where some of the customers have connected to the grid. However in view of the widespread distribution of the SHS, (as far as 30km), most clients still continue to depend on isolated PV systems.

Most people in the area get their income from farming of mainly maize and groundnuts. NESCO is involved in installation and maintenance of solar PV, and selling of solar light bulbs

The organizational workforce consists of 5 employees, namely, director, manager, accountant and two technicians. Previously the company had a helper but at the time of this case study, the helper was not working. The salary of the employees ranges between US$61.53 [US$PPP136.59] and US$135.36 [US$PPP300.49].

Currently, NESCO has 96 clients that include:

- 51 civil servants
- 21 business
- 12 farmers and
- 8 institutions (including schools)

In the recent past NESCO has experienced declining numbers of clients due to:

- Transfers of civil servants and thus surrendering their PV systems (6 clients surrender and their PV)
- Grid extension to Nyimba by ZESCO (8 clients surrendered the systems upon connection to ZESCO)
- 3 business clients surrendered due to other reasons

NESCO has 5 technicians trained from the University of Zambia. Two of these were trained initially upon company inception in 2000 and three were trained later in 2005.

Nyimba district has recently experienced three major economic developments; these are, electricity grid extension, Television Signal and extension of network coverage of Cellular communication by CELTEL The advent of TV signal in to Nyimba created a market for televisions. Since the grid extension does not reach everywhere, those grid electricity are turning to NESCO for supply of PV systems. On the other hand, the extension of network coverage of mobile cellular communication has brought about the desire amongst locals to own cellular phones. People are again turning to NESCO and expressing desire to have solar PV installed for them for charging cell phones.

Data collection was based on the causal chain in Fig 3.11

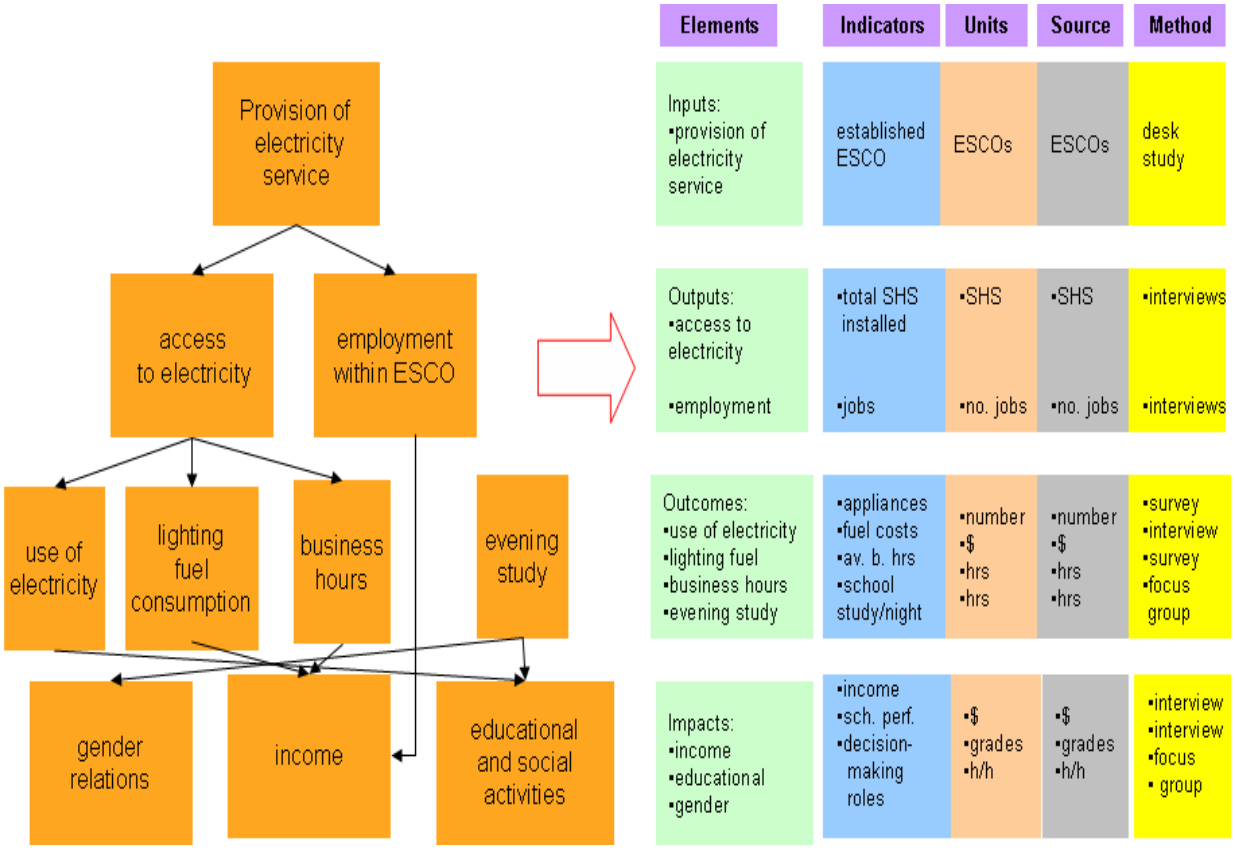


Fig 3.11 Causal Chain for the ESCOs

Data collection involved desk study, key informant interviews and questionnaires, supported by observations.

Data collected through questionnaires, targeted the total SHS customer group in Nyimba and Chipata and a sample of independent owners of solar PV who do not belong to the ESCOs' clientele but have been assisted by ESCO staff to do the installation and servicing.

The questionnaires were designed using information from the causal chain (Fig. 3.11) for each category of the NESCO and CHESO customers.

Results of the case study

In the case of CHESCO assessment of development impacts was done for the categories of beneficiaries that are schools, clinics and churches.

Schools

The two 55Wp PV modules systems fitted at the school that was assessed are for lighting and this provides lighting for weekly boarders for studying between 18:00hrs and 20:00hrs. The teachers also use the light classrooms to prepare their lessons and also to supervise pupils studying at night. The PV lighting has allowed extended hours of studying unlike kerosene and candles and is thus a motivation to

students to study. There was confirmation that the pass rate for grade twelve pupils had increased from 43% to 55% since PV lighting was used in the School.

Clinics

The clinic that was assessed uses four 55WP panels to power a pump for a borehole that supplies 1000 litres/day of water to the clinic[6]. The water is used in the clinic, staff houses and the surrounding community. Respondents indicated that this has alleviated the burden of fetching water from wells far away using buckets. Both members of staff and nearby communities used to fetch water from wells, which sometimes dried. Diahorrea was also mentioned to have been rampant due to poor sanitation at the clinic and the surrounding communities. Women being mainly the ones fetching water were relieved of the burden to carry water for long distances and sometimes some of them would be pregnant and others inflicted by HIV/AIDS.

Churches

The church supplied with electricity for lighting from PV systems had some PV system prior to CHESCO's service. The church would have liked to power refrigerators but it cannot be done using the size of system currently installed.

However the sufficient lighting provided by solar PV systems has allowed ample time for fellowship and improved security at night. Lighting has allowed and improved church duties to be more efficiently executed.

Business

There are two shops that use solar PV supplied by CHESCO and the PV lighting has improved business performance. In the case of one of the businesses, the period of operation has been increased by 3 hours in the evening. Solar PV is also said to be more reliable than the grid, hence the shops enjoy uninterruptible power supply.

Benefits of solar PV for the businesses, emanating from extended business hours are increased revenue due to increased sales brought about by extended hours especially after tobacco harvest by farmers, who are the main customers for these shops. Income also increases because shops continue to sell when other shops have black out due to power failure and hence giving business advantage in the night. Generally more customers come because of lighting. There is also improved security at the shop, and fire risk due to kerosene is a thing of the past.

Households

A large percentage of CHESCO clients are households, scattered in and around Chipata town others stretching as far as 45km from Chipata town. Households belong to civil servants or peasant farmers.

Civil servants

Civil servants that constitute among others, teachers, municipal workers, agricultural officers, enjoy Black/white television set, indoor and outdoor lighting, and radios, from their installed PV of mostly 55Wp size for which they pay a charge of US$16.00 [35.51]. This is an improvement from using candles, matches and kerosene for lighting, dry cell batteries for radios and in some cases car batteries for a black and white television set. Financially PV electricity was presented by respondents to be cheaper than

[6] . The clinic does not subscribe to CHESCO as is the case with other clients considered but the clinic owns the PV system. CHESCO was just used to do the sizing and installation of the PV system and they gave the clinic one year servicing of PV for free. The installation of the solar pumping was carried out in 2001, up to the time of this questionnaire survey the system has run with no major faults or difficulties at all.

using the previous range of fuels . The indications are that households used to spend more (US$19.69 [43.71]-US$24.61 [54.64]) on previous fuels, and shifting to PV electricity translates to a saving of between US$3.69 [8.20] to US$8.61 [19.12].

In households the benefits mentioned included:

- Civil servants such as Agricultural officers are able to read and write reports at night for their fieldwork.
- Entertainment through TV thus communities are informed with regard to harmful diseases and the political situation in the country.
- That there are no more fires due to kerosene and candles
- Ability by the family to cook and wash dishes at night because they are able to see clearly thereby improving the status of women
- Improved reading and concentration in school work for children, as they are able to read in a more conducive environment at night. This is said to reflect in the improved academic performance of the children
- Improved security in the night due to outdoor lighting
- The available data suggests that solar PV may be offering a reduced cost of lighting, thus saving on energy cost.
- There has been interest from the teachers to pursue further studies due to improved lighting due to solar PV as they could study in the night-thus improving their literacy level. Teacher retention has also improved.
- It is also easier for children, girls in particular to undertake household chores such as washing dishes clothes at night to keep the morning free so that they can prepare for school early and arrive in good time at school

Peasant farmers

Farmers equally have similar usage of solar home systems to that of civil servant counterparts and pay equally as much in monthly charge to CHESCO but spend an additional two thirds of the system charge on transport to go a and pay for the solar PV system. Farmers use the solar home systems for appliances such as black and white television sets, lighting and radios.

One of the most important benefits of solar PV to the farming activities is the fact that farmers have extended shelling time of maize and groundnuts for as late as 23:00hrs. This enables them to shell in good time to deliver the produce to the Food Reserve Agency thus availing good income. If produce delivery is late it has profound negative consequences on the farmers in form of delayed income

The impacts of the NESCO project is summarized for the various clients that include farmers, businesses, households and institutions,

Farmers
Similar to the case of CHESCO, farmers supplied by NESCO use lighting to sort out harvest at night and are able to use grinding mill for extend business hours in the night

Businesses

In the case of businesses, groceries, barbershops and restaurants have extended business hours and electrical goods that can be sold and tested using the electricity. Both factors can improve incomes for the businesses.
In another small shop, a 50Wp panel is used to power radio cassette player for testing cassettes during sales, apart from lighting in the evening. Lighting in the evenings helps packaging of the merchandise at the end of the day. The shop owner has also introduced TV sales because of solar PV creating a further opportunity to increase incomes.

Institutions
Only one institution that was interviewed indicated that the lighting provided in the headmaster's office and two classrooms is serving pupils. Teachers are also able to supervise pupils studying in classrooms at night. The benefit is indicated in the improved performance of pupils. Improved pass rate for grade 12 pupils increased from 43% before solar PV lighting to 55% after PV installation The school uses a diesel generator to power computers but this is proving expensive and would like solar PV extended for computers as well.

Households
Households have also confirmed that they are privileged to have good lighting and can use solar PV systems for powering their radios and televisions. In the case of NESCO, households' owners can use their systems to charge cell phones. Outdoor lighting also improves security at night.

The Summary for the development impacts and their link to MDGs for this ESCO project is presented in Table 3.13.

Table 3.13 Summary of development impacts of ESCO project in Zambia and the link to the MDGs

Intervention	Technology	Sector	Proposed link to MDG in Causal Link- here given as impacts	Case Study findings & link to MDG	Substantiation	Remarks
ESCOS	Solar PV Lighting	CHESCO				
		Households	Gender Relations	Safer household environment MDG3	Avoided kerosene & candle fires	
				Improved conditions for household chores MDG3	Cooking and washing dishes in good light and saving day time for education	
			Income	Saved income MDG1	Cheaper than using other combination of fuels by US$3.69 [8.20]-US$8.61 [19.12] per month	Use of kerosene, dry batteries & car batteries turns out to be more expensive than what is charged for solar PV by ESCOS
				Improved Income MDG1	Farmers extending shelling time of maize and deliver produce in good time and condition	
			Educational and Social activities	Informed community MDG3,6 &2	TV programs on diseases and politics	
		Schools	Educational and Social activities	Improved Literacy MDG2	Grade 12 pass rate from 43% to 55%	PV lighting extending studying hours & student motivation
					Good lighting provided Incentive for undertaking Further studies	
		Clinics	Gender Relations	Reduced burden of collection water MDG3	Water pumped-used to be fetched from wells far away	Some of the women were not fit for such chores

			Educational and Social activities	Reduced disease incidence MDG4	Reduced diahorrea	
		Churches	Educational and Social activities	Improved fellowship MDG3		
		Business	Income	Improved business MDG1	Hours of operation extended by 3 hours- as a result of good lighting	PV provides Uninterruptible power supply unlike the grid electricity
		NESCO				
		Households	Gender Relations			
			Income	Farming income improvement MDG1	Extended business hours for farmers sorting out harvest	
				Security, communication improvements MDG3	Use of TV, cell phones and outdoor lighting	
		Institutions	Educational and Social activities	Improved student performance MDG2	Pass rate improved	
		Business	Income	Business improvements MDG1		

Stakeholder responses and Needs

Stakeholders expressed the need for the following:

- Training of a core group in the Department of Energy on the DEA framework and how to use it as a decision making tool.
- To present findings with quantitative indicators as much as possible for the case study report.
- To include aspects such as HIV/AIDS, gender/equity, and good governance in the case study
- To disseminate information to stakeholders and involve government in the process
- Need for invitation of political figures to workshops and possibly present the findings of the case study to the relevant sub committee in parliament.
- Need to introduce articles in the print media on findings of the case study
- Categorization and characterization of target groups in the case study, e.g. households-low income, medium or high
- To consider at what stage of the intervention the AF should be used
- To mention other ESCOs service providers that are in operation to gauge sustainability of such intervention
- To refine the Assessment Framework and then distribute the information to stakeholders thereby creating awareness.

3.3 Conclusions from the case studies

Conclusions on the case studies have focused on how the case studies have been undertaken, the results exposed and stakeholders' consensus on both the case study results and the AF.

Case Study approach

All the case studies fully utilized the Fringilla process in designing collection of information that would indicate impact on development as a result of the interventions that were assessed. The causal chains were crucial in determining what would be assessed and it appears that the clearer the causal chain the easier it was to interpret the results in the context of development in general and later on the MDGs.

There were also inconsistencies with regard to what can be termed outcome and impact and in some causal chains these were mixed or repeated. It is important as part of the refinement of the AF therefore to settle for similar levels of language or terminology that can help to migrate from outcome to impact. This dilemma also complicated the preparation of the Summary tables linking results with MDGs. In some causal chains, the link with MDGs was explicit, while in others further interpretation had to be made to link with MDGs. Some causal chains were taken further to another level to simplify the language/terminology that better reflect impacts before the impacts themselves were defined. For example Mali, Senegal and Tanzania had additional level of *use of outcomes* before mentioning the impacts.

Direct linkages in each causal chain are easier to follow and often tend to better reflect the relationship between the intervention and development impacts. Cross linkages can be useful, but should probably be carefully constructed avoiding indirect links that can result in long-winded deductions.

In relation to data collection, all the case studies used more than one method to gain consensus in the responses obtained with regard to the impact of the interventions to development. Literature reviews, inform interviews, questionnaires, observations and focus groups were used to a large extent by the teams. It turned out that the cultural element was important in ensuring good cooperation from respondents and in the end identifying representative changes that have occurred and could be attributed to the interventions. There was also the danger of collecting data focusing on indicators rather than giving stakeholders freedom to say what else is happening that may be judged as impacts to development.

Whilst all the interventions had clear objectives, there was no mention if projects assessed had logical frameworks or baseline studies undertaken prior to execution of the interventions/projects. All case studies therefore resorted to recall method as the baseline where respondents mostly targeted/beneficiary groups were asked to present the situation before and after the intervention was implemented. Whilst for some instances, the change is easier to notice e.g. before and after electricity came into the village, it may not be so easy to tell whether indoor air pollution for instance has changed after the improved stove has been introduced. The recall method also tends to put the quantitative results into jeopardy, as respondents cannot reflect figures that have occurred for a long period, nor are they in the culture of keeping numbers.

What is important though is the value judgment of the people that are supposed to benefit from the interventions and even to development practitioners, this is a good indicator of progress if target /beneficiary groups themselves agree that their lives are changing for the better. In surveys like these, qualitative responses of change effectively complement any quantitative indicators that may be known.

Case Study findings

Most of the results generated from the case study are generally expected to occur when energy interventions are implemented. Such analysis including linkages with MDGs, are presented in various publications (DFID, 2002; UNDP, 2005; Cabraal et al, 2005 etc.) but often the existence of such impacts are assumed but never confirmed. The case studies have been able to verify some of the expected results but not as assumed, because practically, some impacts are not easy to verify or do not occur due to other external factors. Therefore the expected impacts cannot be generalized by virtue of implementing a particular intervention. For instance grid electricity in Botswana triggered formation of industrial businesses but not in Ghana where a similar intervention was implemented. Similarly, improved stoves were indicated to have reduced indoor air pollution in Senegal but not in Tanzania.

Additional quantitative information, for example on increased number of patients at the clinic, results changes in schools, business turnover and increased number of graduates emanating from the improved literacy, changes in parts per million of reduced in door air pollution, real increase in incomes (not assumed) would add weight to the qualitative evidence often provided by stakeholders. However, such data were difficult and costly to acquire and time consuming to assess and may have questionable reliability too. The Mali and Senegal case studies have made some effort to derive economic and at times environmental benefits but these are more of deductions rather than measured impacts. In such deductions it is probably important that the assumptions are realistic and discussed with key stakeholders in those sectors.

Negative impacts were not adequately treated in the case studies. There are a few cases of TV spoiling students/pupils or lost income to fuelwood traders. It is as if the bias was to look for positive impacts. Obviously the planning is meant for positive impacts but for appropriate decision making positives and negatives should be both assessed, so data collection tools ought to allow for that.

Case studies have been able to yield useful value judgment from stakeholders interviewed but mostly in qualitative form. Quantitative impacts were mostly estimated from secondary data and some limited questionnaire responses. Often to arrive at a quantitative indicator requires some elaborate if not winding deductions and this may be marred with uncertainties. In such circumstances it may be useful to see what impacts are said to have occurred and isolate such impacts for detailed data collection that will provide for quantitative indicators. This of course will entail demand for more resources.

The narration on impacts of interventions to high-level development including to MDGs varied, as presented in the Summary tables. In some instances the link with MDGs was verifiable by the way indicators were presented, in other cases, the link could be indirectly inferred for the summary. It is therefore imperative that the indicators provided are distinguished for each level of the four-level chain.

There are also incidences of forcing outcomes to MDGs, without either showing evidence or indicating that it originates from the respondents. This is biasing results and this will not satisfy stakeholders. Similarly use of proxies needs caution, as other external factors affect the result. This was best demonstrated in the ICS for Tanzania, where trips to collecting fuelwood were not necessarily a factor of fuelwood consumption but of other social elements that people who collect vary and some collect less fuelwood than others. Stakeholders must see credibility of the AF in producing some believable results before they are subjected to other deductions. There are also opportunities to reach second level impacts e.g. moving from improved education to improved income or from healthy to productive nation. Unless verified by respondents or monitored data, analysts should avoid making such deductions if there is no adequate evidence for that.

What is interesting is that the case studies were able to expose poor intervention planning. For instance the management of the RCS/REGE in Botswana and REGE in Ghana caused supply disruptions to electricity consumers. In Tanzania, intervention was focused on providing energy without understanding the vulnerability of the water resource to be pumped. Where the AF is to be used for project monitoring, then Causal Chain and data collection should cater for the adequacy of inputs and how activities are being carried out besides consideration of outputs-outcomes and impacts. The case studies emphasized these last 3 levels, probably since the projects had long been implemented.

There was also the issue of extrapolating results of isolated location to the country programme/project, which may be construed as unfounded as each situation may be different, so such extrapolation should not be driven by creating a convincing indicator. The link with MDGs also should be clearly indicated not as achieving the goals but as a potential to contribute to the goals. The MDGs themselves have targets and if 2 people in a village indicate a positive link with MDG, one has to cautiously present that not necessarily as a contribution as it is insignificant.

Impressions on the AF

Case Study Results

The assessment framework has all the components to provide the necessary thought process and data collection that can be used for impact assessment of energy intervention on development. The AF itself

has indicated its potential as a planning tool for feedback into the project while it is going on and evaluating the projects at end or after it has been completed. The kind of results obtained in the case studies supports that.

Stakeholders

The case study results were seen as a confirmation of the development impacts that are usually hypothesized to occur but are never verified to have occurred

Stakeholders in all the countries where case studies were carried out see the potential of the AF as a collective planning tool that can be useful for M & E of projects and as such should be adopted for wider scale studies. In addition to that they would want to know what will happen to the AF after the DEA project ends and who will own the product to roll it out. The emphasis is on the need for an effective dissemination strategy for the AF.

Stakeholders in the countries involved are seeking steps to explore ways of integrating it in all the sectors for proper planning and evaluation of interventions.

Opportunities for AF use are seen beyond energy and additional socio-cultural indicators were recommended for inclusion e.g. land issues where forest resources are concerned and understanding if women are really empowered if they save time.
Stakeholders would like to see refinement of the AF, its documentation and training of core groups in the utilization of the AF especially those involved with M&E.

The stakeholders realize that until monitoring is introduced for projects from their initiation, attribution of impacts will be an outstanding issue since energy is a cross-sectoral issue. Meanwhile it suffices to refer to baselines of information that is known or recalled. The possibility of establishing baselines before case studies occur was considered important to show changes when interventions have been implemented.

There was realization that all stakeholders representing the development sectors ought to be involved in the process thus ensuring energy's rightful place in development. Involvement of stakeholders in defining indicators and in all stages of impact assessment, ensuring findings/information conform to their needs is considered crucial. Specific indicators should come from specific cases by users,

The stakeholders would like the assessment framework to be simple and easy to use, if it is to be widely used and in addition propose the production of a manual for assisting assessment of the projects using DEA assessment framework. Some country stakeholders would like the AF to make inputs into the M & E of their national development programmes.

Stakeholders also believe that the AF should be widely publicized in journal articles and to decision makers such as parliamentarians.

4 The Way Forward

The important aspects to address at this stage are how to improve the AF, where to apply it and how to disseminate it.

4.1 How to improve on the AF

The ultimate aim of the AF is to obtain credible results that can be consistent and arrived at in a way that can be repeated for other projects elsewhere. To that end experience from the case studies demands that the causal chain be adequately prepared to define the results that can be anticipated at each stage of the chain. Learning from the Institutional Analysis and Development Framework, discussed in the ICS project analysis for Tanzania, the causal chain needs to be elaborated to also reflect the type of project, the critical players (project designers, implementers and funders etc), the beneficiaries, and the M & E should provide a feedback loop into the future project designs or improvement of projects while being executed or after, as presented in Fig 4.1. The causal chain and hence data collection should be able to explore the critical factors that influence success or failure of projects. For example, capital was seen as a determining factor in creation of business in Ghana and the Wind and Solar Irrigation projects in Tanzania failed 3 months after start because there was no adequate assessment of the water resource.

For consistency in the kind of results obtained, there should be some conformity in the terminology associated with development impacts. In particular, the process should be expressed in simple language, since stakeholders have indicated that the AF has to be simple for it to be used. Suggestions provided below could guide what can be included in the causal chain.

- Input - what is invested (money, human and institutions, equipment etc)
- Activities - what is to be/being done with the inputs
- Output - Direct result of activities
- Services - What service the output provides
- Outcome - what the service result in or supports to happen
- Impacts - what the outcome does to the development sectors (if not clear a second stage may need to be established to reach closer to a development terminology- e.g. use of outcomes).
- Link to MDG - what the impact contributes to the MDGs

There should also be an agreed minimum level of data collection with methods sequenced and or complementing each other. The case studies adopted that, but there was no uniformity in which the methods were applied and how they should be applied. Prior knowledge of an appropriate approach such as traditional governance structure, gender relations etc in the communities is crucial for the successful collection of representative data.

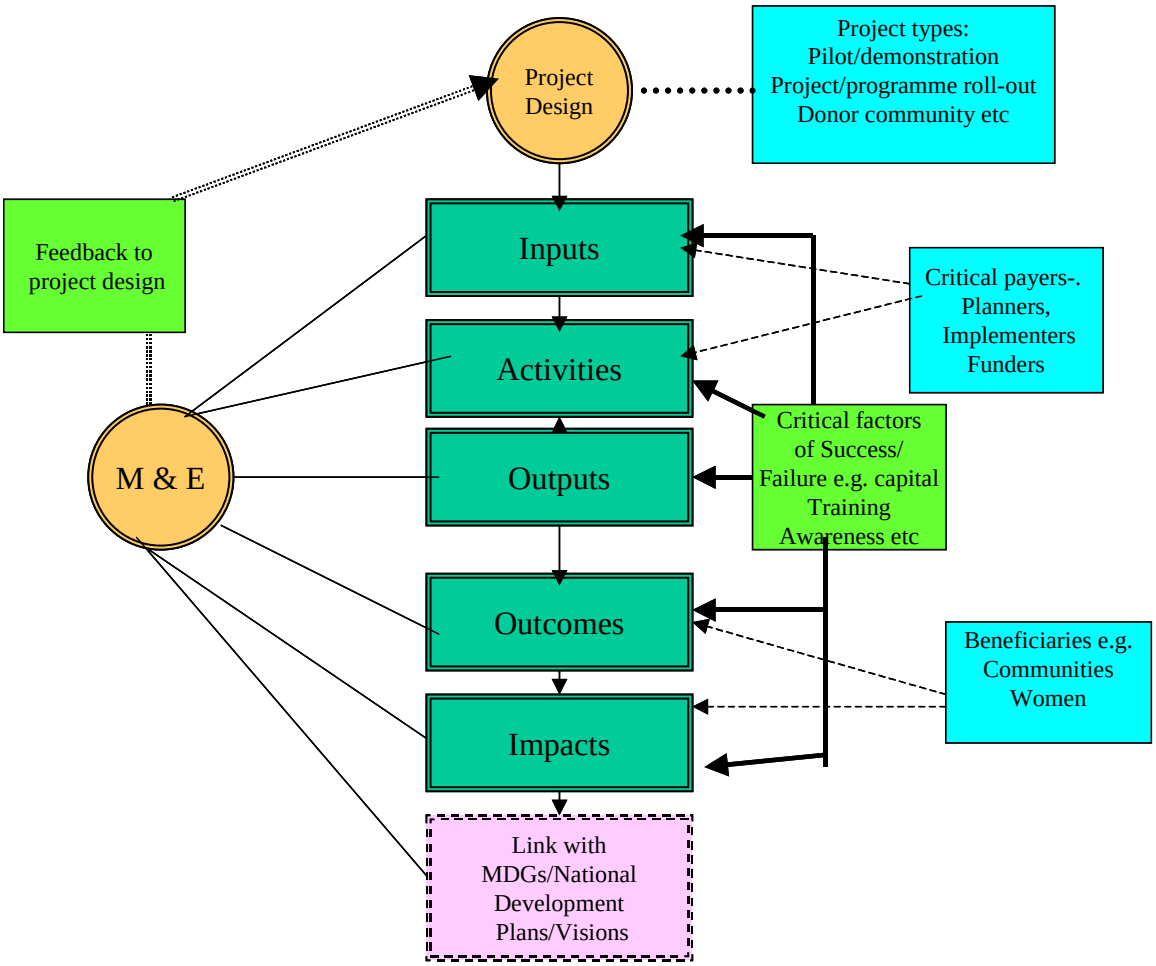


Fig 4.1 The Proposed Elaborated Causal Chain structure.

Although the detailed approach may differ with culture, there should be adequate assessment of responses to validate their representativeness. Questionnaire surveys, interviews, feedback forms and focus groups, complemented by observation and secondary data are the commonly used methods. These were successfully used in different ways in the case studies but not in any uniform format. Another key issue is the need to have local knowledge about the targets communities in order to best apply the methods.

Since the link is to be related to development, it is better to relate impacts to the various development sectors that are affected by the intervention or project/programme, so that stakeholders can quickly realize what the project is doing in their areas. The case studies have done that, but in some, the allocation of impacts was only done at analysis stage and not at the stage of designing the causal chain as well.

The issue of baselines has no simple solution for projects that have already been undertaken and do not have logical frameworks or baseline studies. In this regard, the recall method can still be used, but ensuring that the value judgment of the respondents, particularly project target /beneficiary groups takes precedence. Where the recall method is used, it is best to minimize elaborate deductions or inferences that have no adequate basis. In the case of new projects, then the baseline data should be established as part of the M & E undertaking. The AF should as much as possible avoid trying to prove what is presented in the causal chain but objectively interpret data collected with regard to development

objectives and MDGs. The evaluation of the impacts is not limited to the predefined indicators, but data collection is made flexible to capture any project specific or stakeholder value judgment of the projects. The case studies have as much as possible objectively presented results that have been realized to have been achieved and results also show the indicators of development that were anticipated not to have occurred.

Identifying the critical players including some beneficiaries allows involvement of the stakeholders in the development of the causal chain and data collection tables and methods and indicator analysis. For this purpose, the idea of a Multisectoral Task Group (MTG) is recommended, that will be engaged at project design stage or assessment of case studies or M & E in general.

Application Areas

Critically the AF can be used at any stage of a project: design, execution, end of project and years after the project is complete. The AF is adequate for project design or planning, however it is important to know the peculiar needs and requirements of the type of project that is to be carried out and adapt the framework to suit their purposes. The project design can be assisted by the causal chain, when the development stakeholders (MTG) come together and represent what outputs, outcomes and impacts they want to see achieved in their development sectors. The reflection in some of the case studies that presented sectors affected by the intervention, shows that the AF can be used to plan the anticipated results and also be used to check if those results are being achieved through M & E. Before starting the project, it is therefore crucial that the AF captures what need to be evaluated and how that will be monitored (both quantitative and qualitative).

M & E will use the aspects defined in the AF to collect relevant data that can then be used for evaluation. Monitoring is the regular collection and analysis of information to inform decision-making, ensure accountability and provide the basis for evaluations and learning. This can be done on a quantitative (e.g. time spent, expenditure etc) and qualitative (e.g. satisfaction of beneficiaries) basis. Regular M & E has been undertaken to reflect if resources have been well spent with little regard to monitoring and evaluating impacts on development. The AF has been demonstrated to be effective to provide outputs, outcomes and impacts at any stage as long as the right data have been collected. The framework has the capacity to provide the results critical players would want and also how the project has impacted on beneficiaries (refer to Fig 4.1). During execution of the project, the causal chains and data to be collected can be tailored and refocused towards the objectives that are desired. Data collection can also focus on evaluating inputs and activities, by designing tools that request for data on these aspects of the chain and this can provide a feedback system into improving the project implementation while it is being executed.

For end of projects, improvements on how the project should have been conducted can still be collected, but in the recall methods, some of the information may not still be remembered. The emphasis for end of project and later impact analysis, can be placed on sustainability of the outcomes and impacts achieved.

There was realization that all stakeholders representing the development sectors ought to be involved in the process thus ensuring energy's rightful place in development. Opportunities for AF use are seen beyond energy and additional socio-cultural and economic indicators were recommended for inclusion e.g. land issues, governance and macroeconomic factors.

How to disseminate the AF for M & E

There have been suggestions on how the AF can be disseminated, the purpose being to allow its wider use for impact analysis of development projects.

The stakeholders in all the countries where case studies were undertaken are keen to use the AF for project designs, M & E and impact analysis and have suggested how the AF results can be disseminated and assimilated for use by development practitioners, planners and policy makers.

A number of proposals have been put across with regard to creating capacity for AF use by stakeholders. One is to provide training to a core group in M & E teams in the participating countries. Such training can then be extended to other countries that will have interest. To be able to provide similar level of training, a standard manual on the AF needs to be prepared and used for the training.

With regard to publicizing the AF, stakeholders proposed presenting results to country decision makers such as policy makers and even parliamentarians so that governments adopt it for their M & E. For wide audience, the suggestion is to present the results of the PAF in journal articles.

Stakeholders would like to see refinement of the AF and its documentation provided to them for future utilization in projects M & E.

The stakeholders realize that until monitoring is introduced for projects from their initiation, attribution of impacts will be an outstanding issue since energy is a cross-sectoral issue. Meanwhile it suffices to refer to baselines of information that is known

The possibility of establishing baselines before case studies occur was considered important to show changes when interventions have been implemented. Involvement of stakeholders in defining indicators and in all stages of impact assessment, ensuring findings/information conform to their needs is considered crucial. Specific indicators should come from specific cases by users,

5 Conclusions

The Preliminary Assessment Framework has been successfully tested and has provided results that can correlate energy interventions with development. The limitations have been in the development of quantitative indicators, but there is sufficient confidence in the responses provided by respondents that reflect whether development has been achieved or not in the various sectors affected by the energy interventions. This underlines the importance of value judgement of stakeholders in impact analysis.

The PAF now needs to be improved in terms of yielding credible and consistent results, by ensuring full participation of development stakeholders in the development of the causal chain and related indicators. This is realized to be important in that even if qualitative responses are provided, each stakeholder could best interpret them in the context of development in their sectors.

Case studies have also been successfully executed and stakeholders have seen the potential in using the AF for M & E of their projects.

For effective dissemination, core M & E groups are to be trained and for that purpose, a training manual ought to be designed for consistency in training to be provided. Publicity of the AF is also necessary for its wide dissemination.

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Annexes

Box 2.1 How to undertake surveys/interviews

Prepare a few questions for the interviews

Draft simple questions that are easy to understand

Use open ended questions that can allow flexibility in information provided

Avoid leading questions to avoid biasing the answers

Avoid mixed questions e.g. two questions in one- separate questions e.g. **wha**t then **why** OR **how many** then **what for-not combined**

Approach

Identify the key stakeholders in the village to help with convincing potential respondents (avoiding them from influencing the focus group responses).

Better to start with focus group-and then use other methods e.g. interviews and questionnaires to cross check the responses. Separate out groups of men and female if the other gender may not be free to give responses e.g. culturally in Africa it is thought that females do not talk in the presence of their husbands-so it is suggested that separate focus groups be held for women and males.

Should be free with respondents and appear that you are not superior or different from them

Show politeness and talk slowly with a polite voice so that they understand what you are saying

Chose time and venue most suitable to respondents

Age and incomes are difficult to get but use proxies where possible

SAMPLING

Determined by amount of resources and time allocated and Research Plan should capture that.

Results focus

Numbers do not matter much for focus group. Stay together and keep discussion focused on the same intervention.

FG- good for qualitative but some quantitative responses may be captured

Some of the constraints of Public in Stakeholder/public involvement in focus groups are as follows (Burrow, 2000):

Groups engaged in the public involvement may not be familiar with the technical issues of the project development. This is the case with communities that may be affected by the development.

Special interest groups that may already have biased view on the project may manipulate public opinion. Those who are vocal at meetings often direct the debate at group meetings.

There may be conflict between short term versus long-term wishes of the public as public opinion evolves with stages of development.

PURCHASE PARITY FACTORS
Computed from the IBRD 2006 development indicators, the various DEA countries' *inverse* conversion factors are:

Botswana:	2.20
Ghana:	5.79
Mali:	2.79
Senegal:	2.64
Tanzania:	2.09
Zambia:	2.22

Hence, drawing on Solomon's info, 95,000 Cedi translates into USD 1,000, but the amount of goods you could have bought with that money in Ghana, would have cost you USD 5,790 in the US. In your currency, 6,441 Pula also translates into USD 1,000 but buys you goods worth USD 2,200 in the US.

Exchange rates to the USD

Botswana	BWP 6.1
Ghana.	GHC 9,500
Mali	F CFA 530
Senegal	F CFA 530
Tanzania	1250 Tsh
Zambia	4063 Kwacha