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Encouraging CDM energy projects to aid poverty alleviation

Attachment 3

Assessment of Sustainability Benefits from small-scale community projects

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Centre for Environmental Strategy, University of Surrey
Katherine. Begg, -coordinator-

Intermediate Technology Consultants Schuhmacher Centre, Rugby
Rona Wilkinson

Intermediate Technology Development Group Kenya
Daniel Theuri, Martha Mathenge

Kumasi Institute of Technology and Environment
Harriette Amissah-Arthur, Samson Atugba

Centre for Energy Environment Science and Technology
Hubert Meena, Stephen Mwakifwamba, Stephen Mwakasonde

Contact details

Dr Katherine Begg -Project Coordinator,
Institute for Energy and Sustainable Development
De Montfort University
Queens Building
The Gateway
Leicester
LE19BH
Tel: 0044 116 257 7975

Fax: 0044 116 257 7977
E-mail: **kbegg@dmu.ac.uk**
www.iesd.dmu.ac.uk

Dr Rona Wilkinson
Intermediate Technology Consultants (ITC)
Bourton Hall
Bourton on Dunsmore
Rugby
CV23 9QZ
Tel: 0044 1926 634534
Fax: 0044 1926 634405
E-mail: **ronaw@itdg.org.uk**
www.itcltd.com

Daniel Theuri
Intermediate Technology Development Group East Africa (ITDGEA)
PO Box 39493
Nairobi
Kenya
Tel 00254 2 719313
Fax: 00254 2 710083
E-mail: **daniel.theuri@itdg.or.ke**
www.itdg.org

Harriette Amissah-Arthur, Samson Atugba, Abeeku Brew-Hammond, Sophia Ackom,
Sarah Agbey and Mrs Odamptey
Kumasi Institute for Technology and Environment
Accra Office
72, Old Achimota Rd
PO Box AH420
Accra
Ghana
Tel: 00233 21 256800/01
Fax: 00233 21 256800
e-mail: **kite@kiteonline.net**, **abeeku@kiteonline.net**), **haarthur@ghana.com**), **satubga@kiteonline.net/satubga@yahoo.com**; **kite@idngh.com**.

Hubert Meena, Stephen Mwakifwamba, Stephen Mwakisonde
Centre for Environment Energy and Sustainable Technology (CEEST),
B316 TIRDO Estates,
Morogoro Stores,
Oysterbay,
P.O. Box 5511
Dar es Salaam,
Tanzania. Tel: Fax, email
Tel: 00255-22-2667569
Fax: 00255-22-2666079
E-mail: **ceest@intafrica.com**

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Acronyms

AIJ	Activities Implemented Jointly
BAU	Business As Usual
CAPA	Clean Development Mechanism for Poverty Alleviation Project
CCCF	Climate Change Challenge Fund of the FCO
CDCF	Community Development Carbon Fund of the World Bank
CF-Assist	Carbon Fund Assist for capacity building for the CDM from the World Bank
CDM	Clean Development Mechanism (defined in Article 12 of the Kyoto Protocol)
CER	Certified Emission Reductions (generated from CDM projects)
CO_2	Carbon dioxide
COP	Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC)
COP-MOP	Meeting of Conference of the Parties to the United Nations Framework Convention on Climate Change serving as the Meeting of the Parties to the Kyoto Protocol
CP	Commitment Period
DFID	Department for International Development
EB	Executive Board for the CDM
ERU	Emission reductions units
FCO	Foreign and Commonwealth Office
FDI	Foreign Direct Investment
GHG	Greenhouse gas
GWh	GigaWatt hour
ICS	Improved Cook Stoves
IET	International Emissions Trading
IPCC	Intergovernmental Panel on Climate Change
JI	Joint Implementation (outlined in Article 6 of the Kyoto Protocol)
KP	Kyoto Protocol
MCA	Multi-Criteria Analysis
MHP	Micro hydro power plants
MVP	Monitoring And Verification Protocol
M&V	Monitoring And Verification
ODA	Official Development Assistance
PCF	World Bank Prototype Carbon Fund
SHS	Solar Home Systems
S-L	Sustainable Livelihoods
UNFCCC	United Nations' Framework Convention on Climate Change
UNEP	United Nations Environment Programme

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1 Introduction

This sub report of project R8037 on Encouraging CDM energy projects to aid poverty alleviation deals with the assessment of sustainability benefits from the projects studied and the development of a procedure for a simplified process which could be applied to small scale projects in general.

The assessment of sustainability benefits from small scale projects is important for a number of reasons. Within the text of the Kyoto Protocol is the description of the Clean Development Mechanism (CDM) under Article 12 which states that 'the purpose of the CDM shall be to assist non Annex 1 Parties in achieving sustainable development and in contributing to the ultimate aim of the Convention'. Under the CDM ‘non Annex 1 parties will benefit from project activities resulting in certified emission reductions'. Thus the sustainability benefits associated with CDM projects should accrue to the host developing country partner.

However, how to ensure that this happens in practice is not obvious and there are numerous examples of development energy projects which have failed both technically and in terms of not delivering the expected benefits. In fact we would argue that the successful long term delivery of the certified emission reductions themselves is intimately linked to the delivery of the sustainability benefits and that one cannot happen without the other. In other words we would suggest that the successful implementation of CDM projects and the long term GHG reductions accruing from them are dependent on the successful delivery of the sustainability benefits. Others share this concern and the emergence of the World Bank Community Carbon Development Fund[1] is a measure of the recognition of that concern.

Under the Marrakech Accords the delivery of the sustainability benefits has been dealt with by assigning this issue as a matter of host government sovereignty. It is therefore the host government who will have the responsibility to consider the sustainability issues associated with the CDM projects and assess them during their approval procedures for CDM projects.

In this study we have considered only small scale projects which are due to be 'fast tracked' under the Marrakech Accords with simplified procedures for preparation of the Project Design Document (PDD) and baseline methodologies. The aim of this part of the work has been to develop an approach to the assessment of the sustainability benefits of small scale projects which will form the basis of a simplified procedure for host governments to apply during their approval process.

[1] The World Bank Community Development Fund aims to link small scale projects seeking carbon finance with companies, governments and NGOs seeking to improve the livelihoods of small communities and obtain Emission Reductions at the same time. The World Bank and IETA aim to provide Carbon Finance to small scale projects in poorer, rural areas of the developing world, and contributors to the funds will support projects that measurably benefit the poor and contribute to emission reductions

Although all of the projects have Greenhouse Gas Reductions associated with them, it was realised that the usual macro level objectives such as impact on GDP and national employment figures, did not apply to small scale projects. Instead, small scale projects can have much more direct impacts on a community or people's livelihoods. Thus for the benefits to be analysed they have to be community based, so for instance, the capacitor project in Ghana would not have a direct impact on people livelihoods as it is an industrial project though it would have an indirect effect.

Our approach has been to develop a multi criteria assessment (MCA) model for small scale community projects with the starting point taken from the Sustainable Livelihoods (S-L) approach. Using the S-L approach through a process of elicitation and discussion a series of criteria to be used in an evaluation have been developed and refined. The MCA model has been applied to the set of projects in each country initially by the UK partners to develop the approach and then with each country partner to validate the approach.

From this process we have been able to identify a core set of criteria and a set of priority implementation actions which should accompany any project development if a range of sustainability benefits in keeping with local priorities are to be delivered to make the entire project a success.

This process is not seen as an extra consideration but a fundamental part of the CDM project implementation if these projects are to produce certified emission reductions in the long term and the host is to move to a sustainable development path.

In the following sections we describe the projects, the S-L approach, MCA and the MCA model generated followed by the results from each country and discussion of the implications of the results. This culminates in the formulation of a simplified procedure.

2 Project Descriptions

2.1 Overall Project List

Table 2-1 shows the project final list for each country. Although there were many projects that could potentially provide livelihood benefits we needed projects which were *already operational* in order to assess what sustainability benefits were actually being delivered by the particular project. This aspect, along with availability of data and accessibility, modified the selection to the final list as shown.

Table 2-1: List of projects studied across the partner countries

Kenya	Tanzania	Ghana
MHP, Tungu Kaburi	MHP Uwemba	
Thima Pico hydro		
Sony sugar co Diesel to bagasse cogeneration	*Sugar cogeneration grid to bagasse Mtibwa*	*Biomass Plantation for sustainable wood source Nabari*
Bamburi cement energy efficient kilns	*Kitulanga Charcoal Kilns*	*Charcoal Production, Ashanti Region More efficient kilns*
TEA industry MHP projects		*Energy Efficiency in Small Scale Industries – Capacitor Installations*
	Solar Power for hospital research laboratory Utete	*SHS at Kpasa*
	ICS IREDECT programme	*Biogas project at Appolonia*

The projects marked in blue are where we have across country comparisons

2.2 Tanzania

The list of projects studied in Tanzania is given above. Originally there was a wider range of technologies but some had not become operational in the timeframe for the project and other projects were substituted. The original lists are available as Annex 4.2 to Attachment 4, the report on Greenhouse Gas Reductions Analysis.

2.2.1 Uwemba MHP Project

The Microhydro power (MHP) project (843kW) was constructed in 1984 and has operated from 1991 in Njombe district in Uwemba village. It replaces a diesel generator for Njombe town and Uwemba village and provides electricity for domestic use and small industries including a tea factory, mills and domestic water pumping. It is owned by Tanesco and not the community. There is an increase in the number of local and town households served. It is affordable by middle income domestic users at national rates though some local house structures are not suitable for wiring. There was an infrastructure road improvement associated with the project.

2.2.2 Improved Cookstoves Project (ICS)

The programme was launched in1999 as part of the integrated renewable energy development and environment conservation (IREDEC) programme in Dar es Salaam, Mwanza, Shinyanga, coast region and Kilimanjaro. The project provides for production

and dissemination of improved cookstoves with lower wood fuel requirement at household level in urban and rural areas. It replaces traditional 3 stone stoves and inefficient charcoal stoves in urban areas. Overall it is equivalent to 144MW with 120,000 stoves. It has created small stove manufacturers, produced new designs and markets. The project has involved community participation and training with empowerment of women, increased income with employment, savings in time and in charcoal purchase, and natural resource conservation. The project has demonstrated a need for micro credit.

2.2.3 Utete Solar Hospital Research Project

This consists of the provisions of 12, 75Wp Solar panels for a malaria research unit at Utete district hospital in Rufiji coastal region. It was installed in 1999 and replaced diesel generation though this is still used in rest of hospital. It provides a lighting service, increased 24hr service for computers, communication, refrigeration and an expanded health service to neighbouring communities.

2.2.4 Mtwibwa Sugar Cogeneration

At Mtibwa (2.5MW) and TPC sugar factories (6MW for 22GWh/y), the new plant uses bagasse. It replaces grid electricity for factory needs.

2.2.5 Kitulango forest efficient charcoal kilns

This project involves replacement of a traditional earth mound inefficient kiln to reduce wood demand. The new half orange kiln is more efficient (1/3 more) and has been built Kitulangalo forest reserve.

2.3 Kenya

The following projects were proposed for study from Kenya and are listed in Table 2-1 above.

2.3.1 Tungu Micro Hydro Power

This project is a 18 kW mechanical turbine producing 14 kWe, targeting 300 HH direct beneficiaries and about 4000 individuals indirectly at Chuka, Meru District. It was started in 1999 and is still ongoing. It is owned by the community who designed it from the start. In Kenya current legislation prevents the local distribution of electricity although power can be generated and so the main purpose is to power a new enterprise centre with a hairdresser, welding shop, battery charging facility, tobacco curing and grain milling. It replaces services from a diesel generator for milling and wood and charcoal for tobacco curing. The number of households who have membership in the scheme is 300 but it is available to all. It impacts on education opportunities and the provision of other businesses as well as providing pumped water from the river with filtering.

2.3.2 Sony sugar cogeneration with bagasse

This project is located in Awendo – Sare, South Nyanza and is owned by the Sony Company but it was carried out with community participation. It is proposed that a 15 MW cogeneration plant is built (2003-7) replacing grid electricity for lighting using biomass (bagasse). It has associated benefits of natural resource conservation through tree planting, more roads being built and more opportunities for education through micro credit loans. Though this was not an operational project it will take place within an existing sugar factory structure where these measures are already in place.

2.3.3 Kathamba and Thima pico Hydro power project

These are 2 Pico hydro power schemes rated at 1.2 kW and 2.2 kW respectively supplying 226 HH with power using a micro grid near Kerogoya town in Kirinyaga district. It is a relatively new project implemented from 2000 to 2001. It provides electricity for lighting replacing kerosene lamps and is community owned. They operate on the basis of availability for a membership fee but in practice soft credit facilities mean that there is participation of all. It allows an opportunity for evening study and small enterprises can operate through the evening.

2.3.4 Finlays tea MHP

This is a 1.4MW Mini Hydro serving the 7 Factories in Kericho District built in 1999 - 2002. It produces emissions reduction due to replacement of grid and diesel electricity for machinery in the tea factories. This project has not been realised and there are no sustainability benefit data available.

2.3.5 Bamburi Cement Works

This project is an energy efficiency project for cement production where a more efficient horizontal dry kiln replaces 4 vertical wet kilns at Mombasa and the Athi river. The project was carried out in 1998 - 2001. This project was not assessed on the community project assessment procedure as it is a purely industrial project. It will have more strategic benefits which are discussed separately.

2.4 Ghana

The projects studied in Ghana have been listed in the Table above and are described in turn below.

2.4.1 Appolonia Rural Energy and Environment Biogas project

This project is located in the village of Appolonia, Tema District. It was commissioned in 1992 a part of an initiative from the Ministry of Energy. It was designed to take cow dung and human waste which passes into digesters of capacity $50m^3$. The gas is stored in two gasholders of capacity $13m^3$each and is burned in two generators of capacity 8kW each to generate electrical power of 5kW and 7.5kW respectively. The main output from the project is electricity which replaces Kerosene and candles for lighting. The gas was also supposed to be used for cooking but with the human waste factor, cooking was not considered to be hygienic with this source so that it is only used in the wet season when wood is not available. When the biogas is not available then diesel can be used in the generators. It is owned by community and serves 21 households and 15 streetlights. There are increased commercial activities under the streetlights and the biogas plant produces organic fertiliser for increased food production.

2.4.2 MME/Spanish off-grid Solar PV Rural Electrification

This project is in the village of Kpasa in the Nkwanta district and was implemeted in 1998 to 2001. It consists of 5.5 kwh/m^2/day Solar PV panels supplying a lighting service to 400 HH replacing kerosene lamps. It is owned by individuals in the community
The project involved training personnel and provides improvements in health, an opportunity for education, and infrastructure.

2.4.3 Greencoal improved charcoal kilns project

This project was commissioned in 2001 in the Manso-Amenfie, Western Region. It involves the construction of an efficient kiln for the production of 720tons of charcoal per year. It replaces inefficient earth mounds. The project uses waste wood from the sawmill and is owned by the sawmill. The wood would have been allowed to rot or burned in heaps. The charcoal produced is not the same quality as local earthmound charcoal and is faster burning though one producer does source from the sawmill waste wood. Most of the charcoal is destined for transport to the Netherlands. The kiln has required 7 trained personnel and reduces air pollution, reduces impacts of waste wood and reduces water pollution that occurs when rain falls on the tarry ash left from earth mound kilns. It has no large interaction with the community.

2.4.4 Traditional Energy Unit Project

This is a sustainable forest management project which is community owned. The project is situated in Nabari in the Northern Region and it is proposed that eventually there will be a 60 ha sustainably managed woodlot. It started in 2000 and is currently ongoing and replaces an unsustainable wood supply

The wood is available to the local community at no cost for domestic purposes but they pay a fee for wood for commercial purposes. The project is situated near the village so that the time for gathering wood is drastically reduced. This provides benefits in terms of time for education, other businesses, and reduces drudgery. As part of the project a community centre has been built.

2.4.5 Energy Efficient capacitors

This is part of the UNEP AREED project. We have examined the installation of energy efficient capacitors at 16 industrial sites for power factor correction. The project started in 2001 and is still ongoing. It is designed to reduce power losses at industrial sites. As it is a purely industrial project it has not been included in the sustainability benefits assessment.

3 The Sustainability Assessment Model (SAM)

CDM projects, at whatever level, require some form of assessment of their suitability in terms of their ability to deliver sustainability benefits to the host country. The aim of this work has been to develop a process by which this could be done in a simple, consistent and reliable manner related to the 'real' project situation particularly in the case of small scale CDM projects.

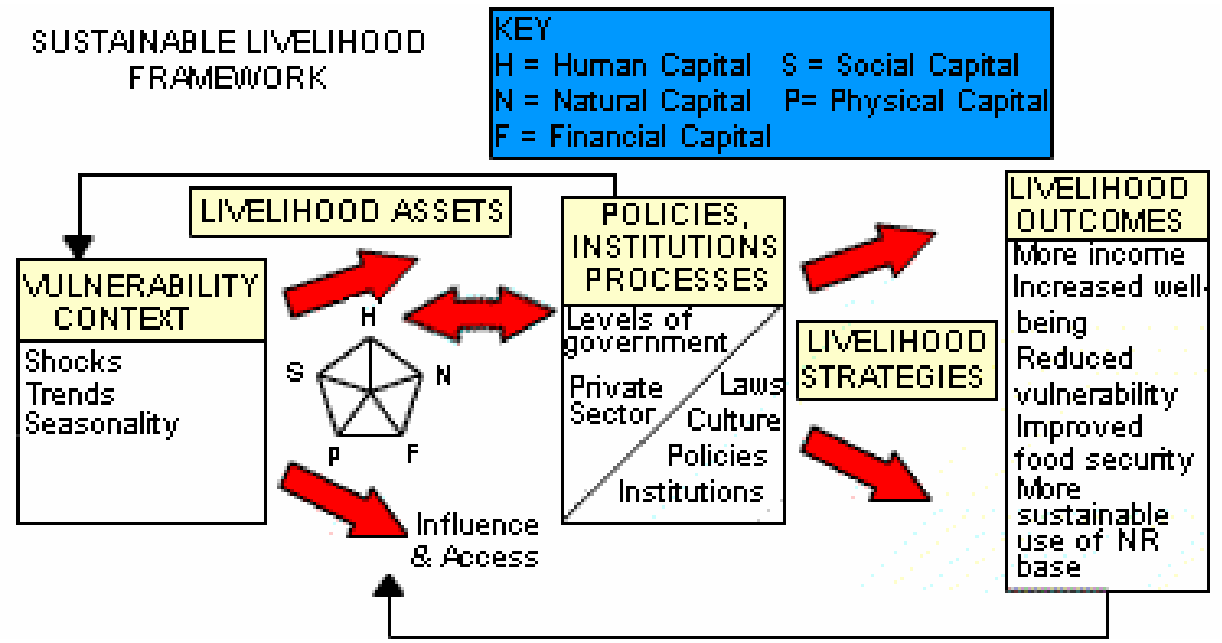
The perspective of the work is the host country perspective where it is faced with a series of possible projects and wishes to assess them in terms of their sustainability benefits.

3.1 Introduction to the Sustainable Livelihoods Approach

The assessment model for the projects is based on the Sustainable Livelihoods (S-L) approach and in this section we introduce very briefly concepts involved in the S-L framework.

The Sustainable Livelihoods approach is used by an increasing number of multilateral donor agencies and NGOs as a way through the complexity and dynamism of poverty into strategic and policy planning. The approach has been found useful in supporting systematic analysis of poverty and its causes. It promotes a wider and better informed view of the opportunities for development activities and their likely impact and places people, and the priorities that they define, firmly at the centre of analysis and objective setting.

There is also a Sustainable Livelihoods Framework that can be used as a tool and checklist when analysing different development activities and their impacts. It is a practical analytical tool for understanding livelihoods systems and strategies and can help understand and manage the complexities of livelihoods. The framework makes explicit the relationships between poverty and vulnerability. The framework used by the UK's Department for International Development (DFID) is shown below:



The framework is not a linear model; the arrows do not denote a direction of causality but instead indicate the dynamic nature of the different types of relationship.

Livelihood is defined as 'the capabilities, assets (including both material and social resources) and activities required for a means of living'. A livelihood is sustainable when it 'can cope with and recover from stresses and shocks and maintain and enhance its capabilities and assets both now and into the future, while not undermining the resource base'.[2]

In practice, the SL approach means attempting to categorise livelihood into a set of assets, namely human assets, natural assets, financial assets, social assets and physical assets. Generating additional income, increasing well-being, assuring a more sustainable natural resource base and reducing vulnerability should, then, enhance livelihood outcomes. The SL approach views vulnerability in terms of shocks, trends and seasonality. Amid all these factors, the workings of policies, institutions and processes (PIPS) are also taken into account.

The SL framework allows the comparison of different development options in terms of their effect on people's livelihoods, for instance a microhydro power scheme on food security and a sustainable forestry project in providing firewood for cooking. It is also possible to use a multi-criteria analysis model with the SL framework and look at the trade offs between projects.

[2] The Department for International Development (DFID) (1999), Sustainable *Livelihood Guidance Sheets.* DFID, London UK

3.2 Multi Criteria Analysis (MCA) and its application to the assessment of sustainability benefits from community based projects

In order to assess the sustainability benefits from projects, the approach used is Multi Criteria Decision Analysis (MCDA). This approach is grounded in the theoretical basis for decision analysis exemplified by the work of Keeney and Raiffa (1976). Details of the approach are summarised and discussed in DETR (2000). The approach explicitly recognises that decisions are subjective; that there is no such thing as an objective decision. Many indicator approaches try to find quantitative measures to represent the issue of interest but this is sometimes not appropriate. In this approach we are explicit about the necessarily subjective nature of the process not only in terms of non quantitative indicators but in the process of choosing the criteria and the value judgements and experience which has influenced that process. 'Objective' measures are subject to subjective value judgements in just the same way and can frequently miss the point of what is important.

This process confronts these issues and makes the trade-offs plain through an audit trail of the judgements made at the time the decision was taken. It can be used at different levels of complexity but is a powerful tool where the problem is complex, has a number of conflicting objectives, involves uncertainty and has a range of stakeholder viewpoints. It has been applied to a wide range of decisions (Von Winterfeld and Edwards, 1986, DETR, 2000). The MCDA approach involves the following main steps

1. Characterisation of the decision context
2. Identification of the options
3. Identification of the criteria important in the decision
4. Construction of a value tree for the fundamental objectives in the decision
5. Scoring the performance of the options on each criterion
6. Weighting the criteria
7. Calculation of the expected value which is equivalent to the weighted sum of the scores over all the criteria.
8. Exploration of the option performance through further analysis
9. Iteration until a requisite model is produced (Phillips 1989).

These steps summarise a process which is more complex than it appears as it facilitates communication between stakeholders at a level which does not normally occur. By providing a framework for thinking round a complex problem it allows a decision to be taken without the need to compromise or have consensus but through the development of a shared understanding of the problem.

In this study the London School of Economics (LSE) model, HIVIEW, marketed by Katalyze Ltd and Enterprise LSE Ltd, is used for processing the data and exploration of the decision.

3.3 Value Tree and Criteria for Analysis

In this study the MCDA technique allowed us to generate a value tree based on criteria generated through discussion of the Sustainable Livelihoods approach outlined in section 3.1. This involved a series of in-depth discussions between the author as facilitator and Dr Wilkinson as expert on S-L. The value tree represents the major tradeoffs in any assessment of the sustainability benefits from projects. These major tradeoffs are then operationalised through the criteria which are at the end of the branches in the tree.

The value tree with its criteria set has been used to assess the projects and explore their strengths and weaknesses in order to generate understanding of what was happening within the projects. It also allowed us to check how meaningful the assessment is on the criteria across a range of projects and accompanying project context as well as across the range of country partner stakeholder perspectives. It is *not* intended to compare projects or project types in the sense that MHP is better than SHS but rather to explore what can be done with a project and what its strengths and weaknesses are to inform the basis for a simplified procedure for project assessment and design.

The value tree is illustrated in Figure 3-1 with the criteria grouped in terms of the major trade-offs. From the tree, it can be seen that the main objective is to maximise sustainable wellbeing (SUSTWELLBEING). This is expressed in terms of the two top level trade offs - minimising effect on natural resource base (NATRESBASE) and maximising personal wellbeing (PERSWELLBEING). The abbreviations in the tree relate directly to the list of criteria which are defined in the next section.

In the Sustainable Livelihoods Approach the objectives or outcomes are listed as increased wellbeing, increased food security, increased income, more sustainable natural resource base and decreased vulnerability with the latter really flowing from all the other outcomes. Thus we have 2 of these outcomes as major trade offs but feel that the others actually contribute to these and are found further down in the tree.

Also recognisable in the tree are the human, social, financial, natural and physical assets in terms of how the project may affect these and thus effect the overall wellbeing. Therefore though our basis is sustainable livelihoods we have analysed and reorganised this into a value tree for an evaluation of projects which can be applied to these *small scale community based* energy projects. Of course the method and criteria can be applied to any development project not just CDM. Surrounding the value tree and the assessment are the policies, institutions and processes related to the country context. The effect of changes in these has to be borne in mind and may lead to policy changes at a higher level.

In the following section we discuss the structure of the tree in more detail and define the criteria that have been used in the assessment of the projects.

3.3.1 Natural Resource Base

This is a top level objective of minimising the effect of the project on the natural resource base. What exactly we mean by that is operationalised using the criteria at the lower levels. Under this main objective at the intermediate level we have sub-objectives in terms of Land, Water and Air which relate to the natural assets from the S-L framework. These are operationalised using the following criteria.

3.3.1.1 Land

We formulated the criteria of food, habitats, forests and land under this sub-objective.

- **Food**

The effect of the project on ability of the community to produce sufficient food or produce crops to sell or animal grazing, in terms of eg irrigation, availability and degradation of land. It can be expressed in terms of change in volumes or qualitatively

- **Habitat (HABS)**

The effect of the project on flora and fauna. What are the activities and effect of the activities? This criterion does not deal with the effect on wood supply from forests.

- **Forest**

The effect of the project on forests as wood resource and natural product resource. This can be expressed in kgs wood conserved and amount of natural products conserved.

- **Land**

The effect of the quality and quantity of land used for the project.

3.3.1.2 Water

This sub-objective has only one criterion that encompasses the different aspects of the water supply for cooking, drinking and washing. We treated water for irrigation under the food criterion.

- **Water Supply**

The effect of the project on water supply for washing, drinking, and cooking, particularly its quality for the future. This can be expressed in l/day or the effect on maintaining volume available and any contamination of the water supply. Consider the sources, quantity and possible contamination routes.

3.3.1.3 Air

This sub objective is concerned with minimising effects on air and is disaggregated into GHG reductions and air pollution.

- **GHG reductions (GHGREDN)**

The effect of the project in terms of reductions in GHG emissions compared to baseline kg CO_2/cap/y.

- **Air Pollution (AIRPOLL)**

The effect of the project on air quality due to SOx, NOx, particulates etc emissions.

This is not the effect on the health of the community, which is considered separately, but the effect on all ecosystems and consequent wider health effects external to the village. This criterion is more of a wider global effect eg brown cloud over Asia.

3.3.2 Personal Wellbeing

Referring again to Figure 3-1, this is the other main top level objective and means that we wish to maximise our personal well being. It is clear therefore that in this assessment we are trading off personal well being and natural resource base. We express what we mean by personal well being in terms of the Social support networks assets and the Income and trade assets. These are further disaggregated into Empowerment and Human assets under the Social assets and Financial and Physical assets under Income and Trade.

The value tree thus encapsulates and operationalises the main objectives of the S-L approach namely increased well being, increased income, more sustainable natural resource base, improved food security and reduced vulnerability to shocks and changes.

3.3.2.1 Empowerment (EMPOW)

We express this aspect in terms of the social aspects and networks associated with the project. Specifically the criteria are Marginal Groups, Social Networks, Wider Base and Security.

- **Marginal Groups (MARGGPS)**

What activities and capacity building associated with the project have affected the women, weak etc marginalised and given them a voice?

- **Social Networks (SOCNETS)**

The effect of the project on social networks in terms of institutions and families etc in the community. This can be expressed as e.g. number of new institutions, more social occasions.

- **Wider Base**

The effect of the project in terms of the new external connections to information on other projects activities, training and people able to help.

This criterion has been found through discussion to overlap to quite a large extent with the criterion on access to funds and though both are included in these analysis Funds would be dropped from the final list of criteria.

- **Security**

The effect of the project on crime prevention.

3.3.2.2 Human Resources (HUMRES)

This aspect is expressed in terms of the human skills developed , effect on education , effect on provision of jobs, effect on freed time

- **Skills**

Effect on building up more and or new skills e.g. mechanical, management

- **Education (EDUC)**

This concerns the effect of the project on the opportunity to improve level of education 3Rs literacy, for all ages, women and children.

- **Jobs**

The effect of the project on number and diversity of jobs and raising quality of jobs: number and type of job but in relation to a purpose.

- **Health**

The effect of the project on local human health of outdoor and indoor air pollution, preventing diseases, acute respiratory inhalation, burns, backache etc and provision of health services.

- **Time**

The quality of life effect of the project from freeing time from drudgery. It is up to the people what they do with the time.

3.3.2.3 Financial

The financial aspects are expressed in terms of the effect of the project on Funds, Income generation and affordability

- **Funds**

Effect on ability to get access for community to appropriate funds

- **Income Generation (INCOMEGEN)**

The effect of the project on income generation or trade activities from the project including access to markets. This is not same as jobs, It is about more opportunities to increase income as long as markets exist and access is possible e.g. grow garlic, extend hours of opening, have income from a new job. It relates to the effect on number and diversity of jobs and raising quality of jobs.

- **Affordability (AFFORD)**

Cost to the community of the service provided by the project as a percentage of income ie is the service provided an economic burden or not? Can the poor have access?

3.3.2.4 Physical

This sub-objective relates to the need to increase the physical capital for the community and is expressed through the infrastructure, the energy and the dwelling criteria.

- **Infrastructure (INFRA)**

This is the effect of the project on increasing infrastructure. The extra benefits delivered by a project e.g. for transport, water sanitation and shelter and health services

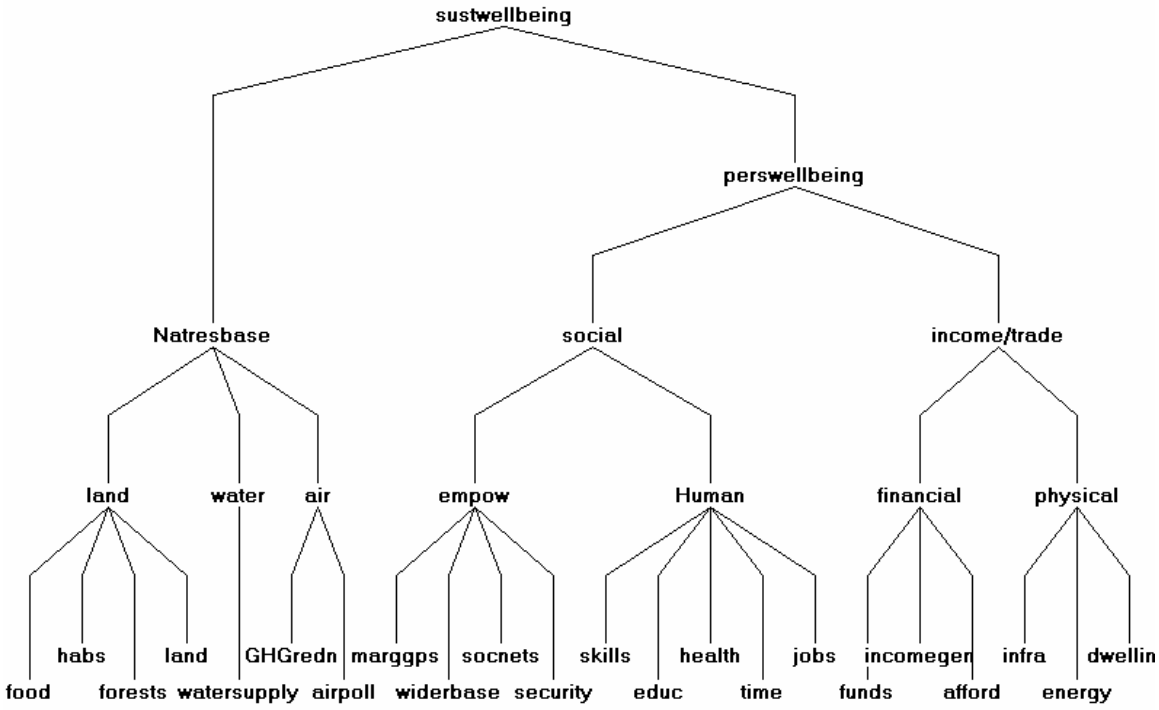
- **Energy**

The effect of provision by the project of a level of energy service on total energy needs of community i.e. does it bring people up the ladder to sufficient energy resource to meet their needs?
This is an overall assessment of how the project contributes to their existing general need to increase access to energy services.

- **Dwelling**

The effect of the project on shelter in terms of new houses or improved quality of houses and whose houses are improved.

Figure 3-1: Value Tree



The abbreviations are explained in the preceding text which defines all the criteria and objectives.

4 MCA assessment

The assessment involves scoring of each of the project options in the country on each of the criteria set out above. The criteria are then weighted and the sum of the product of weight times the score for a criterion are summed over all the criteria for each option to give an expected value for each project. This allows the overall performance of the option on the criteria set to be assessed relative to each other and allows sensitivity analysis on uncertainties to be carried out and the robustness of the project option assessment to be explored. The model also allows exploration of the 'balance' of the option in terms of it major objectives and sub-objectives. Normally one would want options to be well balanced otherwise they may perform apparently well in terms of the expected value but will always have a major weakness. In addition the advantages and disadvantages of the options can be explored. In this analysis, this is very useful in finding ways in which options may be improved. It also leads to identification of key implementation actions for improving projects.

4.1.1 Data Collection

The data on which the analysis is based was collected by the country partners for the projects discussed in section 2. Questionnaires were prepared based on the criteria listed above from the value tree and an example questionnaire is given in Annex 3.1 to this Attachment 3 of the final report. Annex 3.2 provides a summary of the data collected for Ghana. Site visits were carried out and local input to the questionnaires was gathered. However this is a retrospective analysis and data availability was a real problem in this study. The cogeneration plant in Kenya is still at the feasibility stage and so the data was based on this study and on existing practices for the company.

In the previous DFID study we were able to tap into other surveys and reports which had been carried out but this seemed to be lacking for the projects studied here. In addition the questionnaire was long and fairly complex so that it was extending existing knowledge.

The data collected for each project was used as the basis for the scoring of the projects on the criteria. This was done initially by the UK team to test the model. The final form was based on the inputs elicited from the country partners on the criteria for each of the projects. The assessments are therefore available in the audit trails for the assessments in Annex 3.3.

4.1.1.1 Data Quality

Many of the questions could not be answered as data was not available. There was also a problem for country partners in understanding the context of the study and why the data was important. In many cases quantitative information which would have been appropriate for the analysis did not exist. Not all the data needed to be quantitative as

discussed earlier. We explicitly recognise in this study that not all criteria can be assessed in quantitative terms which can be meaningful.

The problem of data availability has been picked up independently in the final workshop discussions and is discussed in Attachment 5.

4.1.2 Scoring

The options were scored using relative preference scales.

An example is shown in Figure 3.2

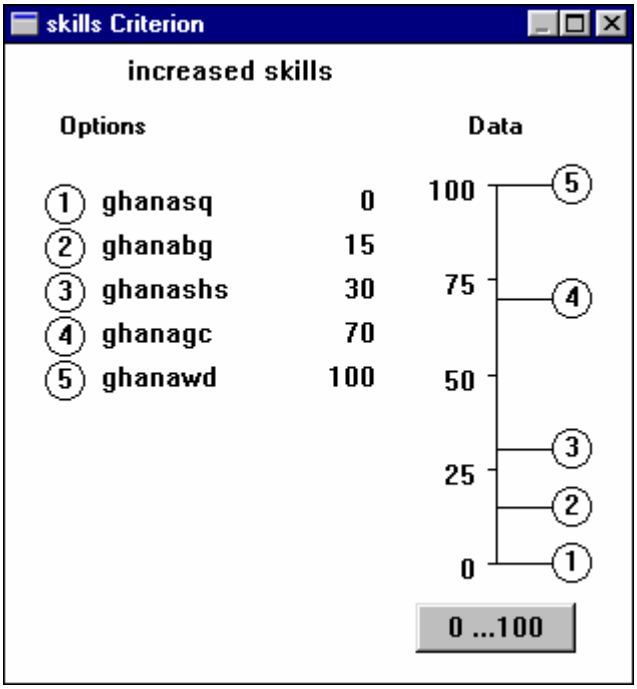


Figure 4-1: Relative preference scale

The option most preferred on the criterion is scored at 100 while the least preferred is scored at 0. This is a relative preference scale so that it is the ratios of preference that are important. The SHS project scored at 30 means that the increase in preference in moving from that option to the most preferred is roughly twice the decrease in preference in moving to the least preferred option.

Each of the options for each country was scored on the criteria in this way. The audit trail for this is given in Annex 3.3.

4.1.3 Weighting

The criteria are weighted according to the 'swing' weighting method which is described in DETR (2000). This involves identifying the most important or least important criterion and then comparing each criterion in turn with the most important criterion with the weight depending on the difference between the top and bottom of the scale and how much the person or group cares about that difference. For example the difference in performance from least preferred to most preferred option on a criterion may not be large but may be considered crucial in the decision. Cross checks for consistency are also made with other criteria.

4.1.4 Results from Country Analysis

For the each of the partner countries the relevant projects which were analysed are shown in **Error! Reference source not found.**. It is of note that in all cases the projects are compared to the Status Quo and that the numbers in the table correspond to the numbers in the following diagrams. In each country the projects were compared to the Status quo situation with no energy intervention. It is important to note here that the assessment procedure is not relevant to *non community based* projects such as the cement works improved efficiency project or the power capacitors project.

Table 4-1: Projects assessed using SAM

OPTION	Kenya	Tanzania	Ghana
1	Status Quo	Status Quo	Status Quo
2	MHP, Tungu Kaburi	MHP Uwemba	Biogas project at Appolonia
3	Kathamba/Thima Pico hydro	Solar Power for hospital research laboratory Utete	SHS at Kpasa
4	Sony sugar co Diesel to bagasse cogeneration	ICS IREDECT programme	*Charcoal Production, Ashanti Region More efficient kilns*
5			*Biomass Plantation for sustainable wood source Nabari*

The analysis was carried out both with the inputs from the partners in the study countries and also with Dr Wilkinson.

Typically the overall performance of the different options would be compared and in a normal decision context the option with the highest expected value would be chosen for further investigation. These overall performance results are given in the audit trail but are relative and are dependent on the specific project circumstances in terms of how the

project was implemented and what the cultural background is. It is *not* an assessment of project types or that one project type is better than another. It is important to realise that what matters is the performance relative to status quo or to projects considered to be successful.

What we are showing is that all projects can deliver a range of benefits provided they are implemented with the necessary capacity building and technology transfer requirements in place.

4.1.4.1 Overall Performance of projects in partner countries

The relative performance of the community-based projects studied in the partner countries relative to the Status Quo is shown in Figure 4-2, Figure 4-3 and Figure 4-4.

These show the performance of the options over a range of possible weights for one of the major trade-offs; maximising the sustainability of the natural resource base. The x-axis gives the range of weights which the trade off can take (keeping all others in the same ratio) and the y-axis is the overall weighted sum of the scores on the criteria making up the trade off. The vertical red line is the current weight assigned to the trade off in the analysis.

Ghana

In Ghana, the project option with the highest benefits was the Sustainable wood project which was robust across all possible weights on the natural resource base and conversely on the personal well being trade off. With increasing emphasis on the natural base the preference converges for the Sustainable Wood and the Biogas project.

For the weight adopted in the analysis there is little difference between the biogas and the Solar Homes Systems at Kpasa though biogas would be preferred. With increasing weight on the natural resource base then the preference for the SHS declines.

The charcoal kiln project was a commercial project which contributed very little to the community needs and was designed to solve a problem of waste wood from the Sawmill and address overseas markets. It does not address local markets or the community. For these reasons it was not much preferred above status quo though there are obvious benefits for the environment and it is still worth doing.

Kenya

The best performing project was the Tungu MHP project. This was robust over all possible weights on the major criteria. The cogeneration project for the Sony sugar bagasse was the next best performing project on the criteria. However the preference for this project declines as the weight on natural resource base increases.

The pico hydro plant was less preferred and shows a similar decline in preference with increasing weight on the Natural resource base.

All projects were preferred compared to the Status Quo that increased in preference with increasing weight on the Natural Resource base.

Tanzania

In the case of Tanzania the preference for the options was robust over all possible weights on the Natural Resource Base and also on the Personal Wellbeing. This means that the options dominate each other in the sense that each is better than the next preferred over all the major criteria.

The most preferred project was the Improved Cookstoves project, which as discussed above, is robust while the next preferred is the MHP followed by the Solar project. This latter was located at a hospital with only some impact on the local communities.

As in the other country results the Status Quo was the least preferred.

Figure 4-2: Performance of project options in Ghana

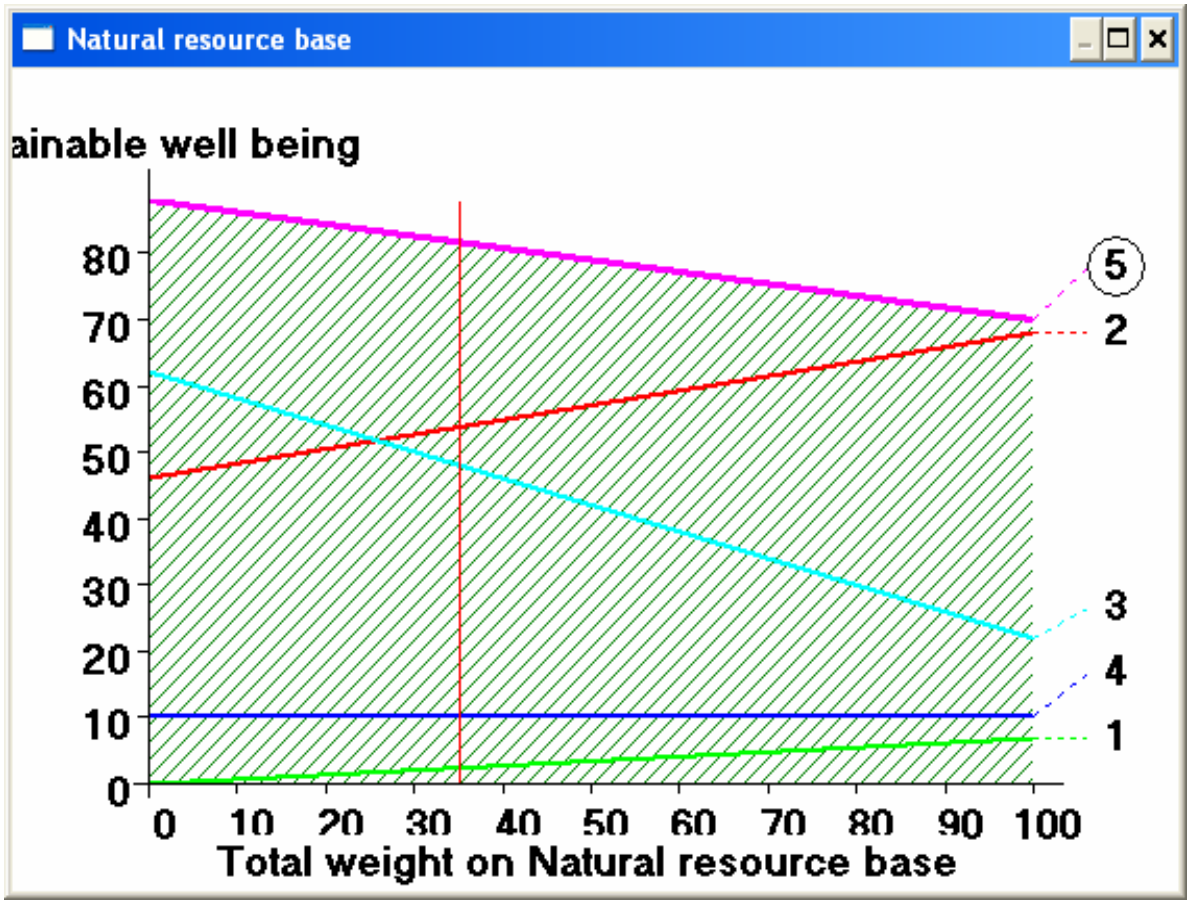


Figure 4-3: Performance of project options in Kenya

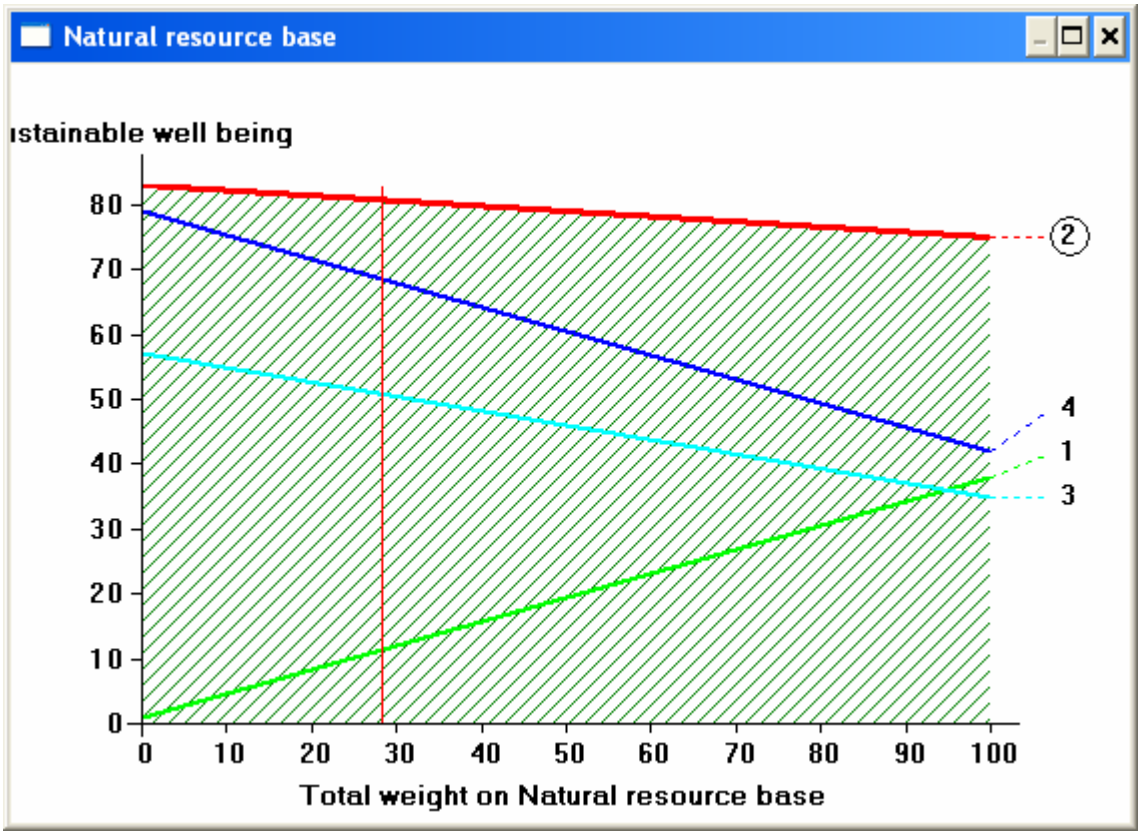
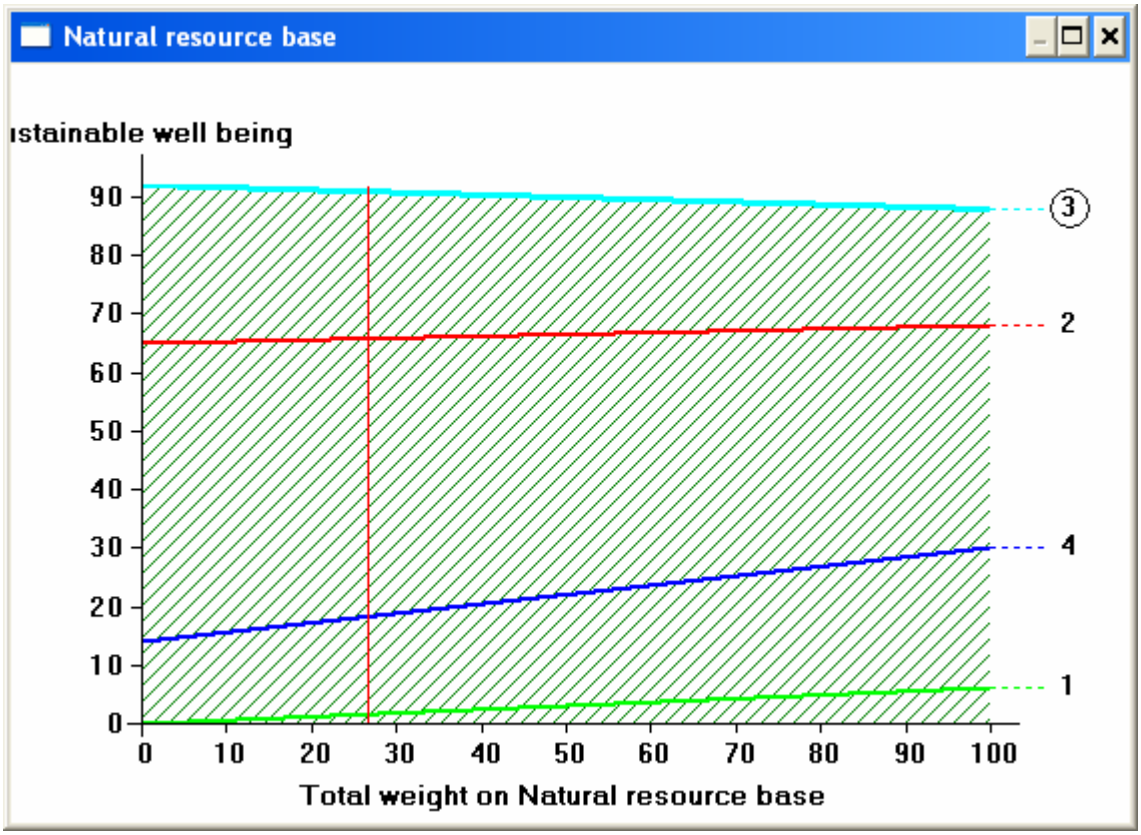


Figure 4-4 Performance of Project options in Tanzania



4.1.4.2 General Conclusions

- The performance of the projects was related to some extent to the amount of benefit produced so that larger projects or programmes of small projects were relatively more preferred.

- All projects were preferred compared to the Status Quo

4.1.5 Balance in the Project Benefits

It is important that an option is well balanced on the major criteria otherwise there will be a serious weakness in the option which will eventually cause problems either during implementation or during operation possible leading to failure. This is commonly the case with decisions and is the reason why we consider this aspect of the options rather than finishing the analysis with the choice indicated by the overall performance Expected Value. The results are illustrated in Figures 4-5, 4-6, and 4-7. The numbers refer to the projects listed in the table above. The x-axis is the performance of the option on the objective of maximising the sustainability of the natural resource base. The y-axis is the performance of the option on the objective of maximising the personal well being. To perform well a project should be located in the top right hand corner of the graph. The diagonal from the origin to that point is the line of balance.

Ghana

In the case of Ghana, the most preferred option, the sustainable wood project is well balanced but the options, biogas and SHS are not so well balanced.

For the biogas project more needs to be done to increase the performance of the project in terms of the personal wellbeing criteria while for the SHS more is required to improve the natural resource base performance. The other options performed relatively poorly on both the major trade offs.

Kenya

Again the most preferred option, the Tungu MHP was well balanced, performing well on both the Natural resource base and on personal wellbeing. However the next preferred option the Sugar cogeneration plant is less well balanced needing to do more on the natural resource base,

The Kathamba PHP needs to be improved on the Natural resource side before it can be well balanced but is not too far off target while the Status Quo was not balanced at all.

Tanzania

In common with the other countries the most preferred option is again well balanced. In this case, the other options are also fairly well balanced requiring just a small improvement in personal wellbeing.

4.1.5.1 Conclusion

- This analysis indicates that though some projects appear to perform well overall they can be flawed if attention is not paid to the relative balance between the major tradeoffs in the decision. In this case these are the personal wellbeing benefits and the natural resource base benefits.

Figure 4-5: Balance in the options from Ghana

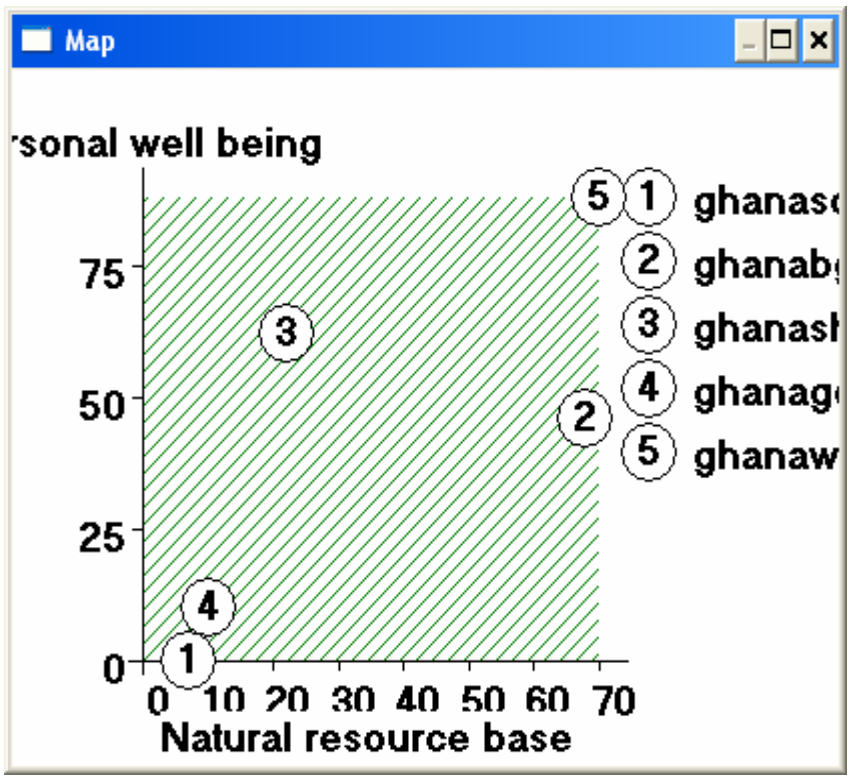


Figure 4-6: Balance in the options for Kenya

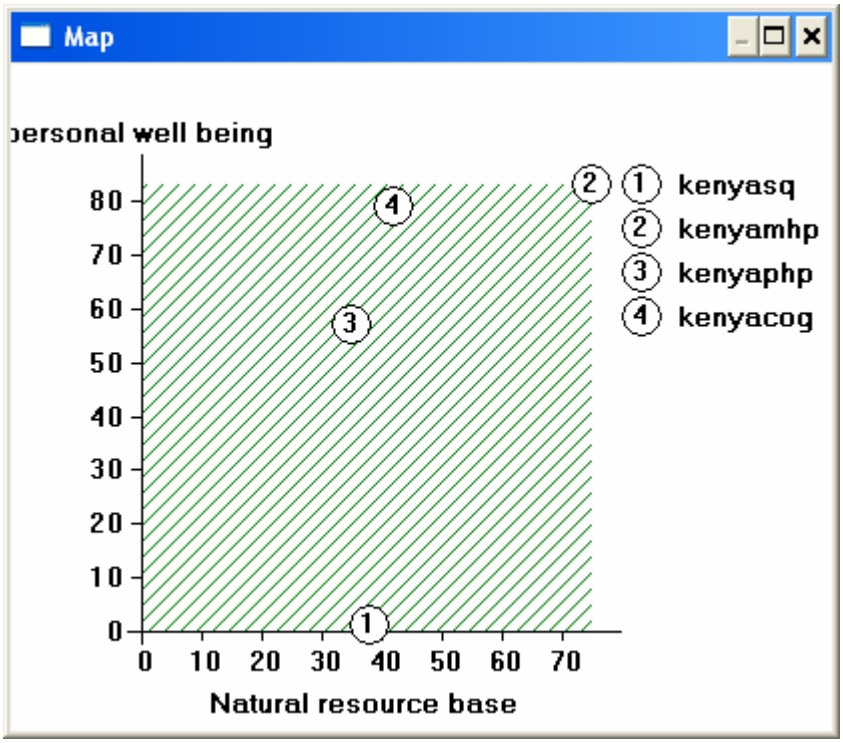
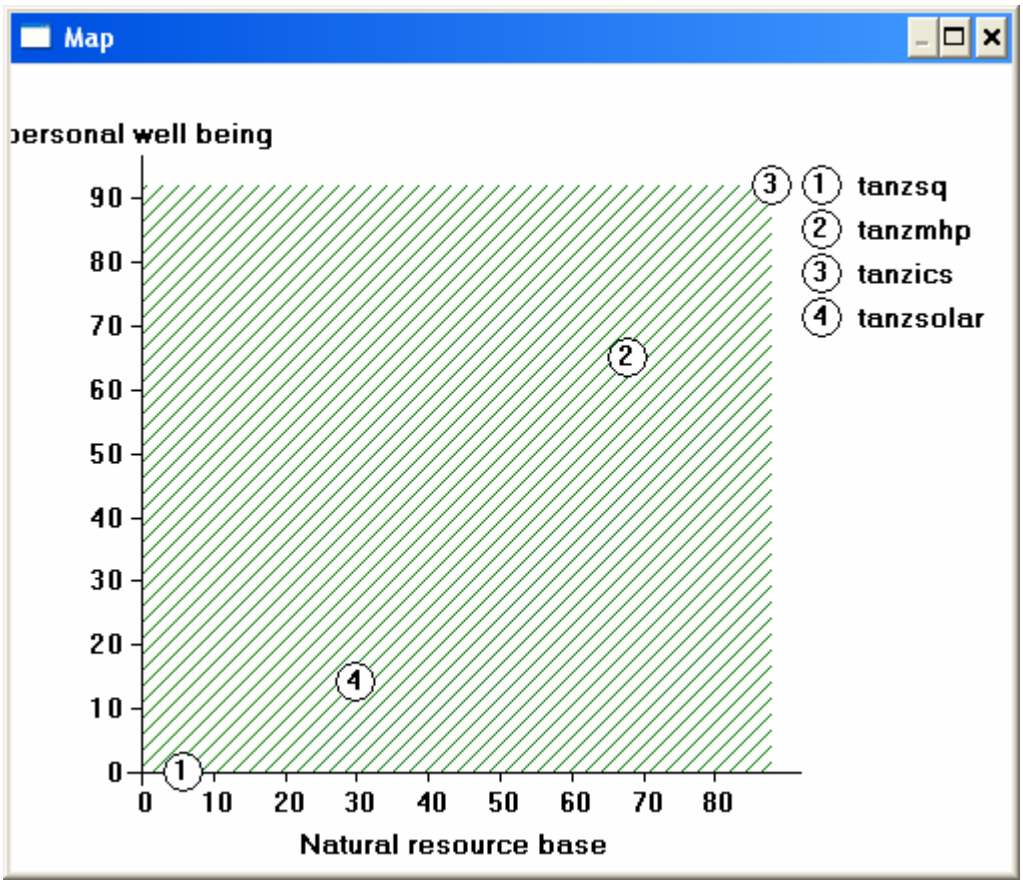


Figure 4-7: Balance in the options for Tanzania



4.1.6 Criteria Set

In this approach the criteria set was derived from the S-L approach. In a normal decision conference the criteria would be elicited from the relevant stakeholders to the decision. As this is not a typical decision context and we also felt it was important to ground the assessment in a widely recognised and applied framework we used the S-L framework as a starting point as discussed earlier. It was therefore important in the analysis to check how comfortable the country stakeholders were with the criteria set used and if the criteria were in fact meaningful.

4.1.6.1 Comparison of criteria sets across countries

Figures 4-8, 4-9 and 4-10 show the list of criteria in order of importance for each country project set. The criteria are abbreviated in the diagram and have been explained in detail in section 2 of this attachment 3. On the left column we have the intermediate objectives e.g. HEALTH maximising the health of the community. In the next column we have the abbreviated criteria. The weight which the criterion contributes to the decision is given in the next column and in the final column under SUM, we have the cumulative total weight in the decision going down the criteria. The bars on the far right are an illustration of the weight on the criterion.

The criteria are weighted on the difference between the top and bottom of the scale and how much they care about that difference. Thus the weights are designed to distinguish between the options and depend on the range on that criterion for the option set available. For the Kenya and Ghana project sets the criteria are all weighted quite closely from about 2-7% in the decision while for Tanzania the range is 0.9 to 10% of the decision. As the weights on the criteria are spread across all the criteria rather than being concentrated in a few criteria we feel confident that most of the criteria set are relevant for an assessment procedure.

For the all three countries the criteria with least weight in the decision vary but dwelling is consistently given a very low weight. This could be because of the low range of effect on this criterion for the projects studied in this analysis and we would therefore not eliminate it from a general assessment procedure.

The criteria group with the highest weight in the decision varied though the '*marginal groups'* criterion was consistently highly weighted. In general they were mixed across the natural and personal well being criteria with some overlap between countries.

In discussion it became obvious that though defined differently, the criteria for Funds and for Wider Base were being assessed in a similar way relating to what new funds had been

accessed subsequent to the project. It is therefore proposed that the Wider Base criterion be merged with Funds so that there is only one criterion Wider Funds under the Empowerment branch.

4.1.6.2 Conclusions on criteria set

The main points from the analysis process can be summarised as follows:

- The criteria set seemed to be meaningful to the participants and they were able to assess the projects on these criteria.
- The original set of criteria seemed to be appropriate for the range of projects covered in this study. The number of criteria which contributed 90% of the weight in the decision encompassed most of the criteria set showing that most of the criteria listed above are indeed relevant and important in an assessment of this type.
- A new criterion, wider funds should replace the wider Base and Funds criteria

Figure 4-8: Criteria set for Ghana Analysis according to weight in assessment

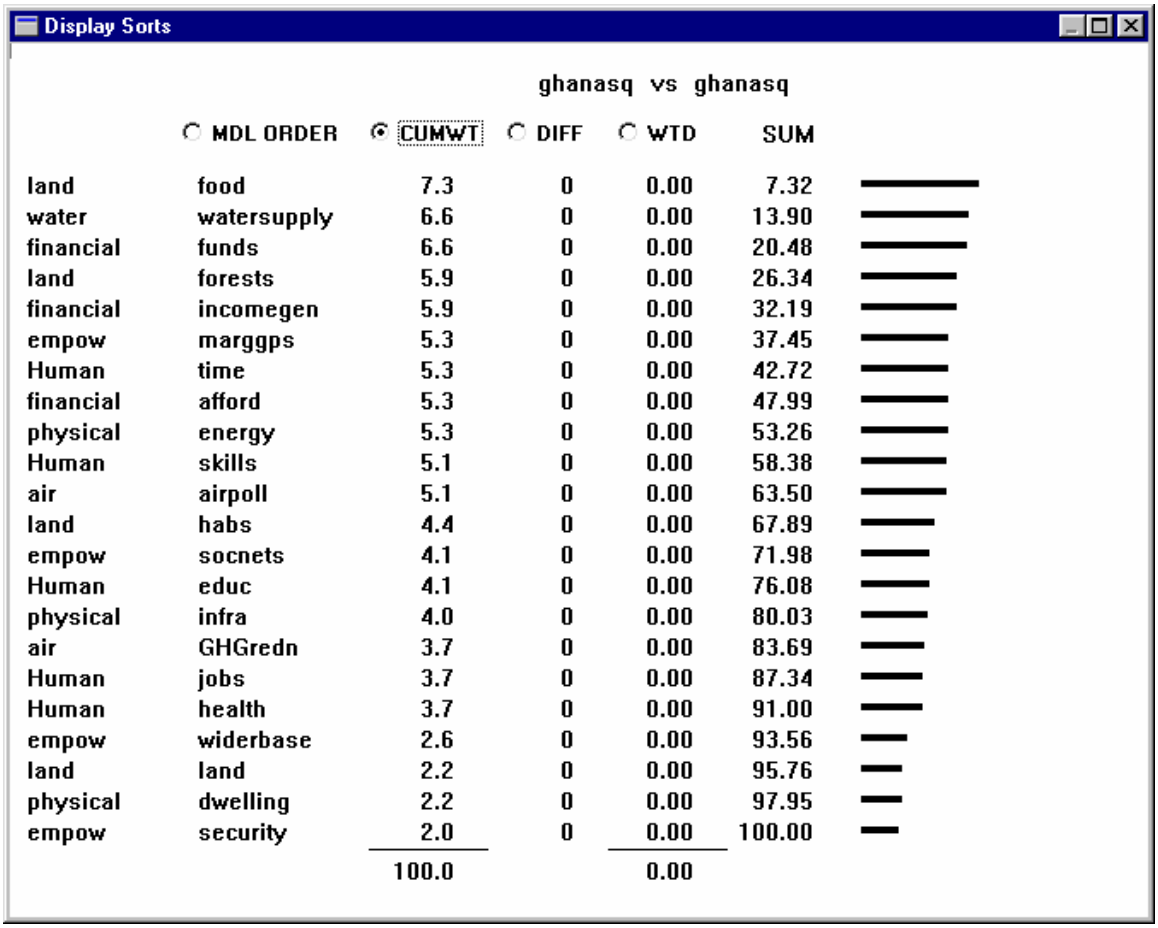
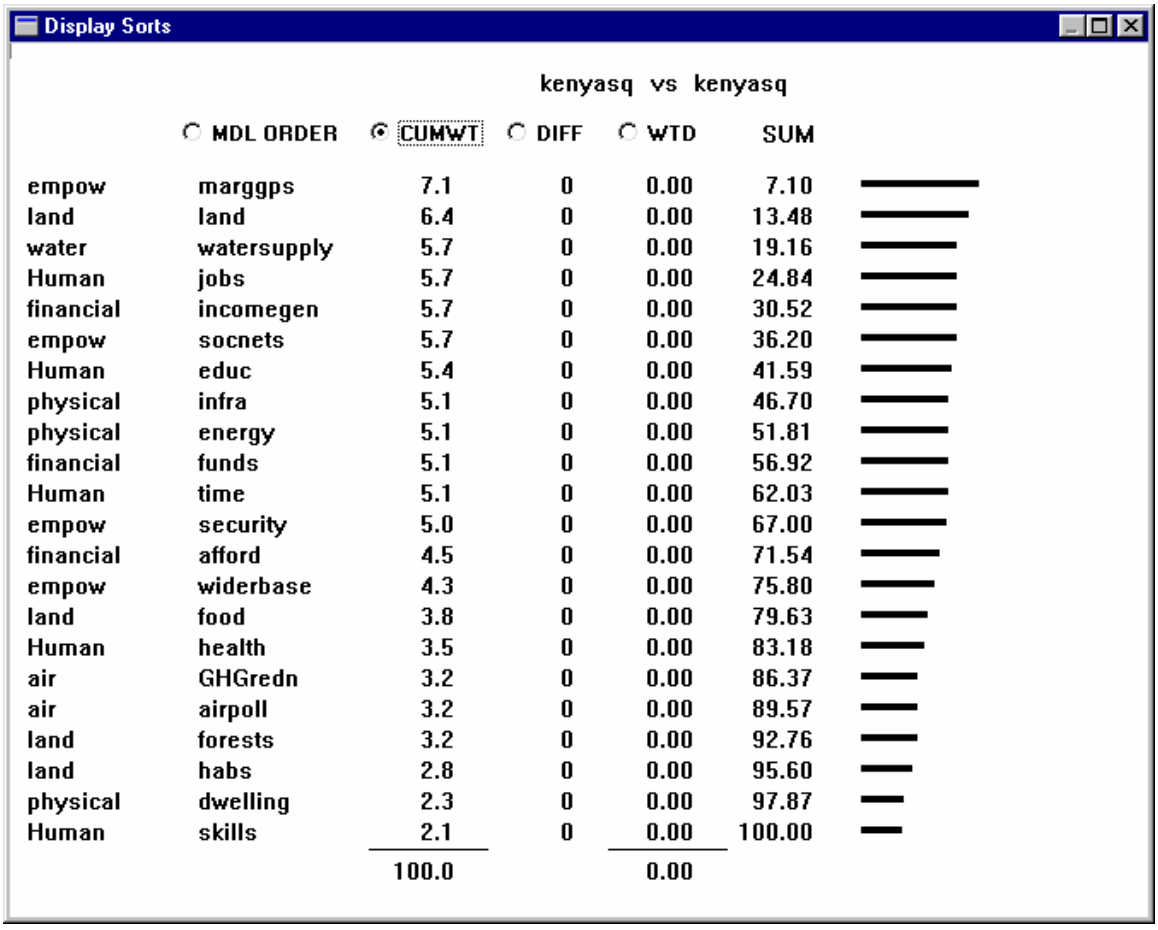
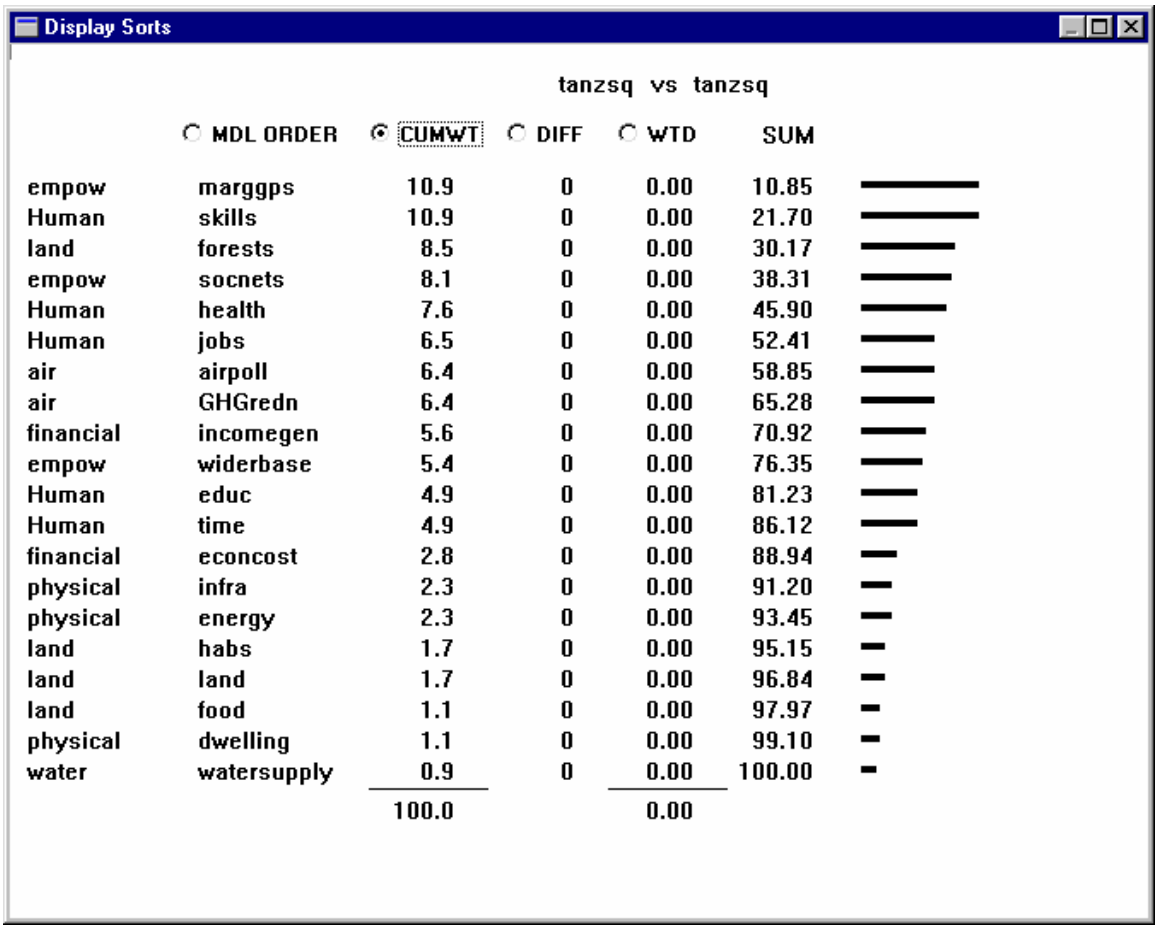


Figure 4-9: Criteria set for Kenya Analysis according to weight in assessment



empow	marggps	7.1	0	0.00	7.10	
land	land	6.4	0	0.00	13.48	
water	watersupply	5.7	0	0.00	19.16	
Human	jobs	5.7	0	0.00	24.84	
financial	incomegen	5.7	0	0.00	30.52	
empow	socnets	5.7	0	0.00	36.20	
Human	educ	5.4	0	0.00	41.59	
physical	infra	5.1	0	0.00	46.70	
physical	energy	5.1	0	0.00	51.81	
financial	funds	5.1	0	0.00	56.92	
Human	time	5.1	0	0.00	62.03	
empow	security	5.0	0	0.00	67.00	
financial	afford	4.5	0	0.00	71.54	
empow	widerbase	4.3	0	0.00	75.80	
land	food	3.8	0	0.00	79.63	
Human	health	3.5	0	0.00	83.18	
air	GHGredn	3.2	0	0.00	86.37	
air	airpoll	3.2	0	0.00	89.57	
land	forests	3.2	0	0.00	92.76	
land	habs	2.8	0	0.00	95.60	
physical	dwelling	2.3	0	0.00	97.87	
Human	skills	2.1	0	0.00	100.00	
		100.0		0.00		

Figure 4-10: Criteria set for Tanzania Analysis according to weight in assessment



4.1.7 Improving Options

A comparison of the projects within the countries allowed an exploration of what the advantages and disadvantages of the projects in their current context are. This can be used to identify the actions that can deliver these improvements. Examples from the current analysis are given for the different countries. The tables are ordered with the main advantages of the project first then decreasing going down the table until at some point the other project performs better and we have the advantages of the other project which correspond to the weaknesses in the current project. These latter are the areas for improvement. Possible key actions are identified which have been carried out in the better of the two projects and perhaps could be transferred to the weaker project.

A comparison of the Improved Cook stoves project and the Micro hydro power project at Uwemba replacing and extending a diesel powered mini grid as described in section 2.2.1 is shown in Figure 4-11 for Tanzania. For Kenya the Tungu MHP project is compared to the Sony bagasse Cogeneration plant in Figure 4-12, while Ghana sustainable woodlots are compared to Biogas plant in Figure 4-13. These results are summarised in the following Tables 4-2, 4-3 and 4-4.
The figures list the criteria as explained above about the criteria sets but in this case the difference between the two projects is shown graphically in the bars at the right hand side of the diagram illustrating the advantages of one over the other. Weaknesses of ICS are in red to the left and bottom.

Table 4-2: Comparison of ICS programme project with MHP in Tanzania

Intermediate Objectives	Advantages of ICS	Areas for improvement for ICS	Possible Key Actions to improve MHP from ICS project
Empower-ment	Marginal Groups. Empowerment of women as manufacturers of the stoves and in charge of tree nurseries so income generators.		Training programme for women for manufacturing and were involved in decision making in workshops
Human	Skills. Increased management, Marketing and manufacturing skills		Training programme for women compared to 2 operators trained for MHP and electricity supply encourages skilled work
Air	High GHG reduction		Decreased use of wood fuel for cooking and large size of programme
Human	More jobs for manufacturing and selling cookstoves with status that a job brings compared to MHP where 14 altogether		Training programme for women
Financial	Income generation Large number manufacturers for ICS while MHP has opportunities for small enterprises to develop		Training programme for women
Human	Time freed from collecting wood compared to less time carrying water under MHP and grinding		Project type, improved efficiency
Air	Air pollution reduction with less wood burned and more chimneys? MHP avoids diesel emissions		Project type, improved efficiency
Human	Health improvement due to less indoor air pollution and for MHP less diesel		Project type, improved efficiency

	emissions		
Land	Forest conservation with 30% less wood fuel used but mhp project planted forest for conservation and erosion reduction		Project type, improved efficiency Additional actions with MHP eg forest planting
Intermediate Objectives	**Advantages of ICS**	**Areas for improvement for ICS**	**Possible Key Actions to improve MHP from ICS project**
Financial	ICS Affordable for many, not clear about very poor as micro credit to come. Savings from charcoal MHP costs more than kerosene		Good organisation and planning for training etc in the implementation of project needed Micro-credit essential if poor to be reached
Physical	Energy: Energy efficiency is high for ICS while MHP gives more scope for lighting and enterprises		Project type, improved efficiency. Moving from low energy base
Land	Land used is small for ICS but MHP 5ha land use change		Project type, improved efficiency.
Empowerment	Social networks: In both projects the ability of the project to influence the social networks is high through the formation of women's groups in ICS and the community management for the MHP.		Implementation through participation and community involvement from the start
Land		Effect on habitats through conservation and biodiversity through planting programme is better for MHP project. Less wood take for ICS may help biodiversity in forests	Planting programme for MHP
Human		Education ; light at night from MHP increases	Project type, lighting service

		opportunity for evening study while ICS may increase possibility of going to school. 90% of children go to school anyway	
Intermediate Objectives	**Advantages of ICS**	**Areas for improvement for ICS**	**Possible Key Actions to improve MHP from ICS project**
Land		Food supply may be improved with irrigation from MHP	Good design of project to deliver relevant services. Participatory discussions form an early stage
Water		Water supply with pumped water is part of project	Good design of project to deliver relevant services Participatory discussions from an early stage
Physical		Dwelling; wiring of houses with MHP for lighting	Project type, lighting service and affordability
Empowerment		Wider base from individuals being able to charge mobile phones is considered greater with MHP than the donor involvement and large policy influence of the ICS	Project providing electricity and unexpected spin offs
Physical		Infrastructure improvement with the MHP was a new road and a dam compared to none with ICS	Additional actions associated with the project which can provide added benefits

Table 4-3: Comparison of MHP programme project with Cogeneration plant in Kenya

Intermediate Objectives	Advantages of MHP compared to Cogeneration project	Areas for improvement for MHP at Tungu	Key Actions for improvement of cogeneration project
Land	Land used is small for MHP but cogeneration effect is large in terms of land take		This aspect is dependent on Project type and baseline condition. Design can help
Human	Health improvement due to less indoor air pollution, less diesel emissions, less wood for tobacco curing, refrigeration, and Cogeneration less indoor air pollution from reduced kerosene but possible increase in air pollution from new plant		Project type dependent , improved efficiency can help
Air	Air pollution reduction with less wood and diesel burned. Cogeneration less kerosene		Project type dependent, baseline replacement of milling and curing for MHP
Empowerment	Marginal Groups. Empowerment of women through community management was a deliberate target in MHP while cooperative set up by company in Cogeneration		Community management scheme from start Cooperative so that some participation but mainly company managed
Land	Food supply improved through the irrigation provided by project		Good design of project to deliver relevant services. Participatory discussions from an early stage
Physical	Energy: Energy supply from MHP provides services for enterprise centre but Cogeneration only lighting		Project type, and service provided as well as initial participatory planning
Financial	MHP Affordable for many, costs same or		Good organisation and planning for

	less than kerosene. Milling is cheaper Cogeneration 40% cheaper		training etc in the implementation of project needed All community is included
Intermediate Objectives	**Advantages**	**Areas for improvement**	**Key Actions**
Land	Effect on habitats unlikely from project while Cogeneration does affect land but actively combating erosion and water treatment		Measures to conserve habitats or minimise effect
Empowerment	Wider base from ITDG and other donors. MHP also changing law on provision of electricity service to domestic consumers. Cogeneration plant is at the company level. More farmers have access to the company.		Project has been used as a showcase and had a major effect
Empowerment	Social networks: In MHP project the ability of the project to influence the social networks is high through the formation of the community management for the MHP, lighting in evening, TV and social hall. In the Cogeneration case there is a cooperative membership but no large effect apart from lighting.		Implementation through participation and community involvement from the start and the service provided by the project. The provision of an additional facility such as the social hall is very important
Human	Time freed from collecting wood for tobacco curing and less time taken to mill as in village already. In addition the project pumps water to the village so saves time in carrying water. The Cogeneration plant does not free time in the same way but increases production time		Project type, and services provided can address areas where time is spent in drudgery.

Water	Pumped Water supply with filter for improved quality is part of project for MHP while Cogeneration plant uses more water in steam generation but recycled treated and discharged 50cm/hr. It may be contaminated and temp higher. There is also some contaminated waste from grease molasses. Cogeneration also provides treated drinking water for community houses associated with project		Good design of project to deliver relevant services Participatory discussions from an early stage. Measures to minimise adverse effects
Intermediate Objectives	**Advantages**	**Areas for improvement**	**Key Actions**
Human		Skills. farmers trained in agro practices, training in running boiler, additional to accounting and management; need more as enlargement For MHP, 2 operators, committee skills, own labour for construction so can transfer to another area,	Training programme for women compared to 2 operators trained for MHP and electricity supply encourages skilled work
Human		Education; light at night from MHP increases opportunity for evening study while ICS may increase possibility of going to school. 90% of children go to school anyway	Project type, lighting service
Physical		Infrastructure improvements	Additional actions associated with

		with the MHP were water supply, mobile phones and power lines and enterprise centre while for Cogeneration the new plant will involve more roads and so is rated more highly	the project which can provide added benefits
Intermediate Objectives	**Advantages**	**Areas for improvement**	**Key Actions**
Financial		The cogeneration plant project is carried out by a company with access to more funds than the MHP but the MHP has already accessed additional funds due to the project	Future activities in the hands of the local community but if participation and management has been carried out well they should be in a position to do this.
Land		Sustainable tree planting for community with the project while MHP plant with tobacco curing saves many trees	Project type and Additional actions with eg forest planting
Empowerment		Security through increased prosperity for all against background of low crime with more benefits from Cogeneration	Depends on project type eg lighting and additional actions
Human		Cogeneration has 22K jobs but low diversity while MHP has 14 but high diversity	Depends on size of project and Training programmes
		Dwelling; upgrade of	Project type, service provided and

Physical		houses with Cogeneration plant as part of job while MHP has no wiring therefore no change	affordability as well as additional measures e.g. as for Cogeneration
Intermediate Objectives	**Advantages**	**Areas for improvement**	**Key Actions**
Financial		Income generation: Cogeneration, scope to expand income generation is high, 25000 and people have high purchasing power MHP has scope to create jobs and income and extend opportunities for working longer and create new businesses	Training programme for farmers on growing methods MHP has enterprise centre so their scope for new opportunities
Air		High GHG reduction. Cogeneration reduces kerosene use for a large number of dwellings. Reductions from wood for tobacco curing and kerosene and diesel in MHP.	Decreased use of wood fuel for cooking and large size of programme

Table 4-4: Comparison between sustainable wood project and biogas project in Ghana

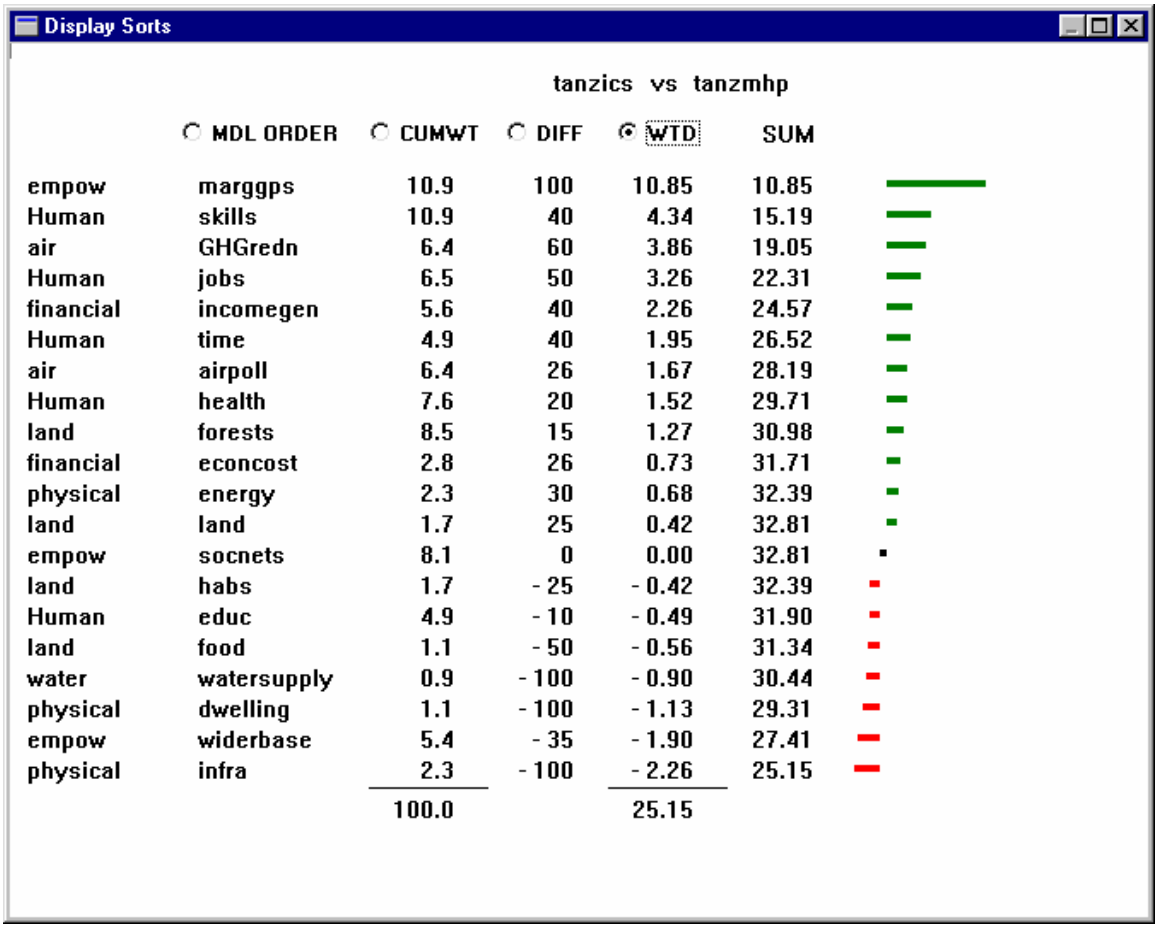
	Advantages of sustainable wood project over Biogas project	**Areas for improvement and key actions for Sustainable wood project**	**Areas for improvement and example Key Actions to improve the biogas project**
Intermediate objectives			
Empowerment	Marginal Groups. Empowerment of women through new women's associations while biogas no empowerment except when use gas for cooking in dry season		Empowerment through the formation of women's groups
Land	Forests: Project provides a sustainable wood source close at hand while biogas has some effect from fertiliser		Depends on Project type Additional actions : sustainably managed wood source
Human	Skills: 11 trained and whole community plants trees while biogas minimal training for 3 and ministry has to fix		Training programme appropriate to project type properly carried out to make sure can be sustainable
Human	Time freed from collecting wood (1-5Km before). The biogas has seasonal time saving when wood too wet and use biogas		Project type, and services provided can address areas where time is spent in drudgery. e.g. provision of a mill
Financial	Funds: additional funds from world bank already and cooperatives can leverage funds while biogas project has not produced further funds		Future activities in the hands of the local community but if participation and management has been carried out well they should be in a position to do this.
Physical	Energy: Energy for cooking for wood project while Biogas has lighting and limited		Depends on resources, Project type, and service provided as well as

	access to electricity for TV etc		initial participatory planning
	Advantages of sustainable wood project over Biogas project	**Areas for improvement and key actions for Sustainable wood project**	**Areas for improvement and example Key Actions to improve the biogas project**
Financial	Income generation: Sustainable wood project has co-operatives which are businesses that increase income for women, harvesting income, beer brewing, cassava roasting. The biogas project provides savings in kerosene, vegetables for sale, drinking bars, shops		Initial planning backed by training programme. Does depend on project. Small enterprises can be encouraged
Financial	Sustainable wood is affordable for many. They do not pay for domestic fuel, only use fallen wood. If cut then costs 150cedis/kg biogas: savings 20% or 10% of income, those less than 150,000 cedis a month cannot afford service -about 50%?		Good organisation and planning for training etc in the implementation of project needed Have to pay attention to overall costs and replacement in future. Design to include most people
Land	Effect on habitats for sustainable wood is high with 7ha of new conserved area of forest Biogas has fertiliser improving soil and sustaining wildlife populations		May be an effect of the project type. Can take measures to conserve habitats or minimise effects depending on project circumstances
Empowerment	Social networks: In sustainable wood project there are cooperatives, women's associations and a community centre. For biogas lighting provides an increase in social gatherings		Implementation through participation and community involvement from the start and the service provided by the project. The provision of an additional facility such as the community centre is very important

	Advantages of sustainable wood project over Biogas project	**Areas for improvement and key actions for Sustainable wood project**	**Areas for improvement and example Key Actions to improve the biogas project**
Human	Jobs: 11 jobs with sustainable wood and 3 for biogas with indirect jobs in both cases.		Depends on size and type of project as well as good planning. A training programmes for jobs is required
Water	Water supply: forests encourage more rain so quantity increased for the sustainable wood project. For biogas the toilets, reduced chemical fertiliser and the dung collected all improve water quality		Project type or Good design of project to deliver relevant services Participatory discussions from an early stage. Measures to minimise adverse effects
Empowerment	Wider base : sustainable wood part of larger project and so effect is greater than for biogas which is also a showcase project		Projects have been used as a showcase and had a major effect
Human	Education: opportunity for education as not collecting wood Biogas provides light, watch programmes, radios, opportunity to study, adult education for a while.		Project type, providing opportunity or lighting service
Land	Food about same for both projects: sustainable wood and growing crops between trees. Existing farms moved but no effect, as planting farms and also trees at beginning then moved. However overall increase in food is temporary. Also were given Soya beans. Was a depleted vegetation area. Now some species medicinal.		Good design of project to deliver relevant services. Participatory discussions from an early stage Additional actions eg given seeds

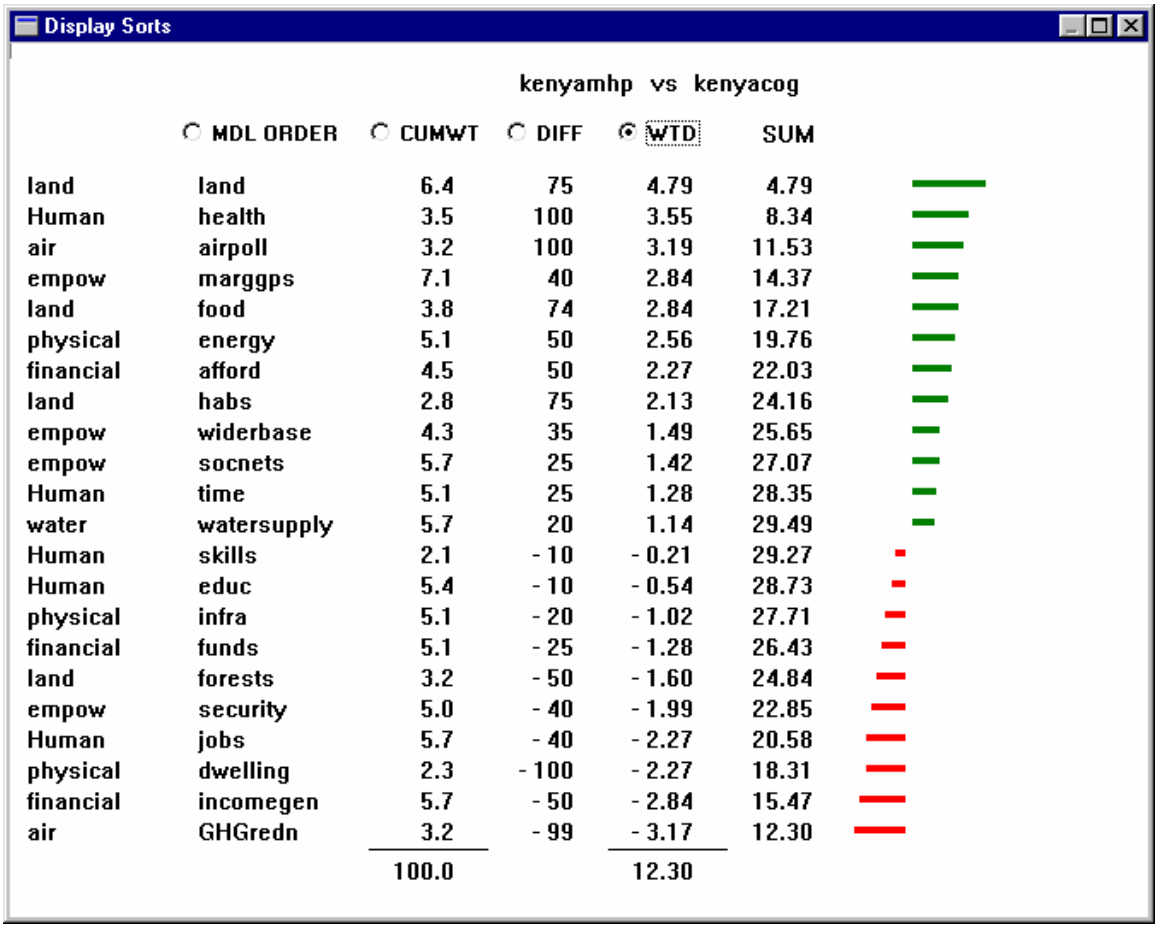
	Biogas: set up vegetable farm next to project to use fertiliser (near Accra so income from market).. 20% seems to real		
	Advantages of sustainable wood project over Biogas project	**Areas for improvement and key actions for Sustainable wood project**	**Areas for improvement and example Key Actions to improve the biogas project**
Human	Health improvement about same for both projects Biogas gives a reduction in kerosene fumes, better waste management, organic vegetables, latrines while sustainable wood gives medicinal plants, less backache and less tired		Project type dependent and gave a range of benefits depending on circumstances of project. For example, biogas lowers risk of burns for kerosene.
Physical		Dwelling; improved wiring with biogas and no effect from sustainable wood	Project type, service provided and affordability as well as additional measures. Wiring , improved construction of dwellings
Empowerment		Security low crime anyway but streetlights for biogas project	Depends on project type eg lighting and additional actions
Land		Land use is small for biogas but large for sustainable wood as farmers had to be moved	Depends on Project type and baseline condition
Air		Air pollution reduction with less kerosene and possibly less methane for biogas while sustainable wood project emissions may be increased	Depends on Project type, baseline replacement.

Figure 4-11: Comparison of Tanzania projects ICS and MHP



empow	marggps	10.9	100	10.85	10.85
Human	skills	10.9	40	4.34	15.19
air	GHGredn	6.4	60	3.86	19.05
Human	jobs	6.5	50	3.26	22.31
financial	incomegen	5.6	40	2.26	24.57
Human	time	4.9	40	1.95	26.52
air	airpoll	6.4	26	1.67	28.19
Human	health	7.6	20	1.52	29.71
land	forests	8.5	15	1.27	30.98
financial	econcost	2.8	26	0.73	31.71
physical	energy	2.3	30	0.68	32.39
land	land	1.7	25	0.42	32.81
empow	socnets	8.1	0	0.00	32.81
land	habs	1.7	- 25	- 0.42	32.39
Human	educ	4.9	- 10	- 0.49	31.90
land	food	1.1	- 50	- 0.56	31.34
water	watersupply	0.9	- 100	- 0.90	30.44
physical	dwelling	1.1	- 100	- 1.13	29.31
empow	widerbase	5.4	- 35	- 1.90	27.41
physical	infra	2.3	- 100	- 2.26	25.15
		100.0		25.15	

Figure 4-12: Comparison between Kenya projects



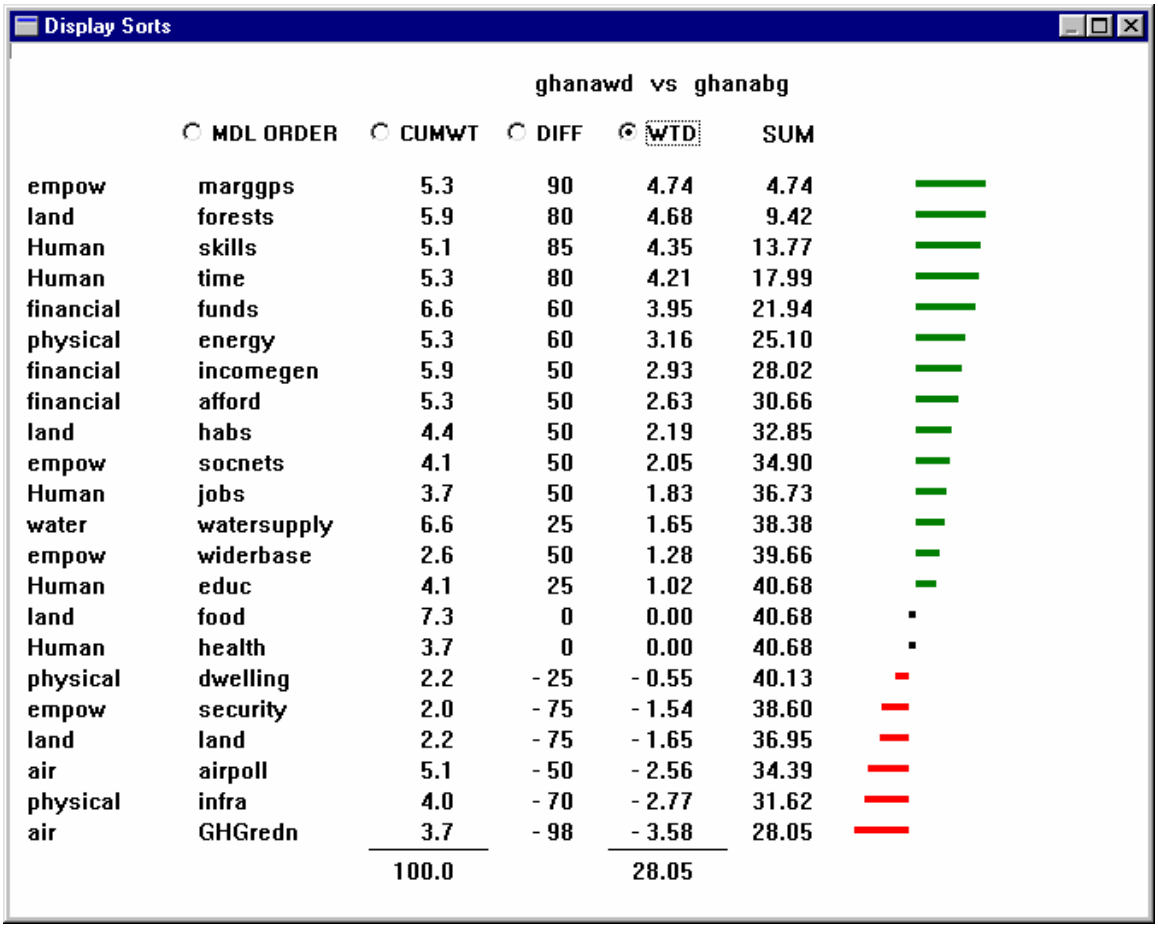


Figure 4-13: Comparison between sustainable wood project and a biogas project

5 Implications

5.1 The Sustainability Assessment for small scale CDM community projects (SAM)

The results discussed above show that the assessment approach we have developed in this study is feasible and workable for small-scale community projects. No other approach addresses these projects in this comprehensive yet practical way. Often macro indicators are used.

The **SAM method** or **a Simplified SAM Procedure** is designed to be used in a host country context to enable a decision to be taken on the approval of a CDM project. This can be done using either the SAM model or a simplified procedure.

The SAM model or the simplified procedure can be used in the following ways.

1. To compare a project with other possible projects or against a benchmark. This allows a comparison of the project and its implementation context to see how good it is for example against the benchmark project or against the Status Quo.
   - It also gives insights into how a project may be improved through additional actions as discussed in section 4.1.7.
   - SAM allows sensitivity analysis using the MCA model on the Policies, Institutions and Processes to test and improve robustness and generate new or improved projects.
   - It allows characterisation of the benefits as discussed in section 4.1.6. and gives an indication how they may be measured
2. To audit the SD aspects using the criteria once the project is implemented.
3. To illustrate the crosscutting role of energy in the delivery of SD benefits.

In order to perform the assessments some of the practical aspects of using an MCA model have to be considered.

5.2 Methodology for application of SAM

The decision to approve a particular project or set of projects is composed of the traditional decision steps. These steps are listed as follows:

- formulation of the options (projects),
- generation of criteria for assessment,
- structure of the option set,
- assessment of the performance of the options on the criteria through scoring the options and weighting the criteria,
- exploration of the total expected value of the options and the 'balance' of the options on the major trade-offs
- improving the options through additional actions

We discuss each of these steps in turn to highlight the issues to be considered.

5.2.1 Formulation of the Options

The model allows projects and their context to be compared. However it is clear from the analysis that project performance on the criteria depends on ***how*** the projects have been carried out and the particular baseline situations for the projects. A simple comparison on project type alone is therefore not meaningful.

From this study we have shown that the delivery of the benefits depends on

- ***The project type and service provided;***
- ***The additional implementation actions (how);***
- ***The baseline situation.***
- ***The size of the programme of small projects or the size of the independent small project is an important aspect for the assessment with the larger projects or programmes considered to be delivering more benefits.***

We therefore propose that the option set is defined in these terms so that the range of information for the assessment is available.

5.2.2 The criteria set for assessment

In a normal decision, the criteria are elicited for each decision context. In this case however for general applicability a criteria set has been generated through discussion based on the S-L approach. This criteria set has been tested for projects in three countries in this study and has been judged to be robust.

The Funds and wider base criteria have been removed and replaced by 'wider funds'. Though this list seems to encompass most of the concerns associated with the projects some additional considerations have surfaced in discussions and have been added to the criteria list.

Resource depletion is the depletion of scarce resources by the project either in operation or manufacture
Effect of the project in stimulating **local supply chains** for spares, maintenance and manufacture.
Amount of **locally manufactured equipment** versus imports.

The criteria set recommended for use in the analysis are summarised in the Box A.

CRITERIA SET for ASSESSMENT *BOX A*

food
forests
habitats
land use change
air pollution
GHG reduction
water supply
marginal groups
wider funds
local supply chain
security
jobs
freed time
health
education
skills
energy
infrastructure
dwelling.
resource depletion
social networks
local manufactured equipment
affordability
income generation

5.2.3 Structure of the option set

What is meant here is that the option set can be composed in a way which will answer some decision problem. If the decision involves eliminating some combination of actions then a series of options exploring the different aspects can be set up.

In this project approval problem we suggest that the projects are compared to a Status Quo option and to a Benchmark project in terms of its delivery of sustainability benefits. A decision can then be taken with respect to their performance against these projects.

5.2.4 Benchmarks for use in the option set

For a host government trying to take a decision on the acceptability of a project in terms of its potential to deliver sustainability benefits, projects could be regarded as acceptable if they can be assessed to be better than the Status Quo and be comparable, though not necessarily as good as, known 'good' benchmark projects. Proposed projects may also be improved by adding actions that have been taken to maximise the delivery of possible sustainability benefits in line with country priorities. However this approval does also depend on checking that the implementation actions are in fact actually carried out.

In Ghana the sustainable wood project stands out as a good project while the biogas project or SHS never fully realised their potential. Thus in Ghana we can recommend the sustainable wood project as a comparison to vet other projects. Of course a project can also be better than the sustainable wood project.

The system also allows for recommendations to be made on improving projects. The charcoal kilns project is a good example of this where the company focussed on its own needs and paid little attention to local needs or concerns. This is shown in Table 5-1.

Ghana

Table 5-1 Overall performance of the options in Ghana for host approval

Project	Sustainability for community	Balance
Sustainable Wood	**high**	**Well balanced**
Biogas Appolonia	**Medium**	**Not Balanced More personal wellbeing actions required**
SHS Kpasa	**Medium to low**	**Not balanced More natural resource base actions required**
Charcoal Kiln commercial	**Low for community**	**Balanced, not many benefits**

Kenya

In Kenya the Tungu MHP project and the sugar cogeneration project are very good projects while the Kathamba Pico plant is assessed at a relatively lower performance because of its size though it is also a good project. The sugar cogeneration plant particularly addresses many of the social needs well above normal project requirements. The Tungu MHP project could be used as a benchmark for comparison with new projects. In common with Ghana all the projects are good projects compared to Status Quo but again they can be improved (Table 5-2).

Table 5-2 Overall performance of the options in Kenya for host approval

Project	Sustainability	Balance
Tungu MHP	**high**	**Well balanced**
Sugar Cogeneration	**medium**	**Few More natural resource base actions required**
PHP	**Medium to low**	**More natural resource base actions but less than for cogeneration, size dependent**

Tanzania

Table 5-3 Performance of options for Tanzania for host approval

Project	Sustainability	Balance
ICS	**high**	**Well balanced**
MHP	**medium**	**Few more personal wellbeing actions required**
Solar	**Medium to low**	**Few more personal wellbeing actions required**

In Tanzania the ICS project could be taken as a benchmark. The MHP seemed to perform well with again size differentiating between the options as well as the extent to which they are oriented to community needs. In this respect the solar hospital project performed less well.

5.2.5 Assessment of the performance of the options

Having defined the project options and structured the option set the options can be evaluated on the criteria set given as described earlier in Section 3. The weights on the criteria can be determined by the 'swing' weighting method and then the weighted sum of the scores over all the criteria are produced for each option in the model. This can also be carried out using a spreadsheet in a simplified procedure. From the results the performance of the options on the major trade-offs of 'Natural resource Base' and 'Personal wellbeing' can be determined to examine the balance in the options which is so vital for the avoidance of problems in the future.

It may be the case that the results show that some projects are not well balanced. At this stage, we can explore the possibility of improving the options. For a host government it would be feasible for them to discuss improvements to be incorporated into the existing proposal to maximise benefits for the host provided they do not entail excessive cost for the developer.

5.2.6 Improving project options with additional implementation actions

We showed in our analysis in Section 4 that options could be analysed in the model to display their weaknesses and their strengths so that actions could be targeted to improve the options to provide balanced good performing projects.

The additional implementation actions are the key additional actions which deliver many benefits which would not otherwise occur and are delivered through the good design and attention to local needs through participatory approaches.

The complexity of the problem can be seen from the fact that the performance of a project on the criteria depends on what is going to be done, how it affects the existing situation and how it is carried out if sustainability benefits are to be realised.

Particularly the social and human criteria are more dependent on additional actions being carried out under the project than on the project type or baseline activities. This forms the basis of simplified recommendations for the use of this work.

Small scale CDM projects to alleviate poverty at the rural community level must therefore be carried out with all the criteria in mind and with funding and people able to implement the project with the key additional actions.

In Table 5-4 examples of additional actions which can be designed into a project are collated.

Table 5-4 Additional Actions to improve options

Criterion	Generic dependence	Examples of Specific Implementation actions
Natural		
Food	-Project type dependent e.g. irrigation from MHP -Baseline activity	-Start new ventures e.g. vegetable farm near market -Give seeds -Replacement activities e.g. cattle grazing
forests	-Project type dependent e.g. ICS sustainable wood fertiliser from biogas -Baseline activity: e.g. tobacco curing with wood	-Active forest planting against erosion -Sustainable tree planting for community additional to project needs -Use of fertiliser
habitats	-Project type dependent e.g. sustainable wood -Baseline activity	-Planting programmes -Conservation measures
land use change	-Project type -Baseline activity	-Transition arrangements
air pollution	-Project type -Baseline activity	-Windows can be fitted -Chimneys can be fitted
GHG reduction	-Project type -Baseline activity	-Size and load factor
water supply	-Project type -Baseline activity	-Pumped water -Filtered water - Irrigation - Water treatment to minimise contamination coupled with treated drinking water to local community
Social and human	Some projects are not at community level	
marginal groups	Depends on how it is implemented	-Training programmes for women e.g. manufacturing, marketing, management -Community project management committee -Women allowed to make decisions in workshops -Women in co-operatives -Formation of women's' associations

wider base	Depends on how it is implemented	-Degree of donor involvement -Policy influence -Company level network -Projects as showcase
social networks	-Project type and baseline activity -provision of lighting service	-women's groups -community management -social hall -community centre provision -co-operatives
security	-Project type -Baseline activity	-streetlights
jobs	-Project type -Baseline activity	-Training to enable jobs to be filled -more jobs with larger size of project
freed time	-Project type and baseline	-focus efforts of project on drudgery activities e.g. replace milling, collecting wood, carrying water, sending messages
health	-Project type -Baseline activity E.g. biogas has better waste management	-refrigeration -clinic lighting -medicinal plants
education	-Project type -Baseline activity	-opportunity for more study with lighting service -TV programmes
skills	-Project type and service e.g. electricity supply encourages skilled work	-Training programmes e.g. agro practices, planting trees
Financial and physical		
income generation	-Project type -Baseline activity	-Training programmes
energy	-Project type and service -Baseline activity	-Participation in planning to make full use of opportunity -training in maintenance -technology transfer for spares and skills required -manufacturing base in country where possible
affordability	-Project type -Baseline activity	-Good management of project -Good training in financial skills -Provision of micro credit to reach the poor

infrastructure	-Project type -Baseline activity	-new road and dam with MHP -streetlights ,toilets, with biogas -water supply, charging for mobile phones, enterprise centre with MHP -new roads with cogeneration -community centre for sustainable wood project
dwelling	-Project type and service -Baseline activity	-wiring for MHP and biogas -improved housing stock with cogeneration
Other possible criteria		
Resource depletion	- Project type and service - Baseline Activity level	-Waste minimisation -recycling initiatives -alternative processes -increased efficiency
Supply chains	-Project type	- training programmes for skills - funding for new and clean sources
Local equipment	-Project type -Baseline activity	-training programmes to build skills for entrepreneurs -funding for start-ups -market analysis

5.2.7 Practical aspects of the use of SAM for small scale community projects

The SAM approach can be used at two levels. The first is the use of the SAM HIVIEW MCA model and the second is as the simplified SAM procedure.

5.2.7.1 The SAM evaluation decision model

The decision analysis MCA approach (DETR 2001) has been discussed at length in section 3. It involves the use of the model HIVIEW and this should be used only after some training in decision analysis techniques and elicitation has been carried out so that a competent facilitator is able to guide the assessment. Such training is available from the London School of Economics. The exercise carried out in this study showed that developing country partners appreciated the use of the model and its potential to be applied to a range of development projects and not just CDM.

The approach explicitly addresses the subjective nature of the judgements which have to be made. This is an intrinsic aspect of any assessment. There is no such thing as an objective assessment. Subjective judgements are made on which criteria to be included and how they are to be treated based on our personal value systems and experience. The

approach is based in decision analysis theory which explicitly treats this aspect by encoding judgements in preference scales and fostering discussion within decision groups so that there is no need for an 'optimum' or compromise solution but all views can be encoded and investigated to see what difference they make in the final decision.

The assessment of the projects in this study was carried out with in-country partners who were aware of the projects under study and who could score the projects and weight the criteria. This is in line with normal practice where the stakeholders for such an assessment should include those knowledgeable about the project and project local conditions as well as those responsible for the overall decision.

The model is available to all country partners but as mentioned earlier the HIVIEW model needs to be purchased and partners need to be trained to facilitate the process with knowledge of decision analysis and group processes. All country partners expressed interest in this and enthusiasm in the process as the methodology has wide applicability to decision problems.

5.2.7.2 Simplified SAM Procedure

In view of the relative complexity of using an MCA model for the assessment it was considered useful to transform some of the elements of the model into a simplified set of instructions to lead people through an assessment. This is elaborated in the next section.

5.2.8 Simplified Procedure for Approval of small scale community CDM (or development) projects in terms of Sustainability Benefits.

For the CDM, the overall approval of projects must take account of their financial additionality with respect to ODA and host government approval with respect to the delivery of sustainability benefits for the host country.

In order for the host government to carry out this latter task we have proposed either the use of the SAM model or a simplified procedure. This simplified approach is based on the criteria set which has been identified and discussed in the previous sections. Though the weights on the criteria were fairly evenly distributed in the three study countries the same results cannot be obtained by simple equal weighting. The weighting of course depends on the set of project options being evaluated and has to be justified in the procedure.

The approach comprises three main parts.

1. An introduction to the procedure.
2. A checklist with
    - A set of criteria and definitions
    - Instructions on how to score the projects on the criteria and how to weight the criteria

- Spreadsheet for calculations
- List of examples of key implementation actions for each criterion which could be added in to the design of the project to deliver the priority sustainability benefits if required (Table 5-4) above.

3. Data for comparison of project with Benchmark project

Ideally benchmark projects would be available for a range of project types but this is unlikely to be available. What we have instead are some 'good' projects and lists of examples of key actions which could be included in the project design to improve the project and help to ensure the delivery of a balanced set of benefits.

5.2.8.1 An introduction to the procedure and road map

The procedure recommended is a less sophisticated version of the SAM model but using the normal MCA procedures.

Initial Information requirements

1. The project description should first of all be given as well as the relevant project participants and their contact details. This should be available already from the simplified Project Design Document (PDD). Size of programme and number of bundled projects is important information.

2. Any project implementation actions should at this stage be highlighted by the developers.

3. The project baseline existing circumstances should then be described in terms of how the service being provided by the project is currently being supplied. At this stage some information on the general energy supply to the community and its existing population considered to be living in poverty is required.

Assessment

The assessment steps are listed as follows:

- formulation of the options (projects) with inclusion of Status Quo and benchmark project
- assessment of the options on the criteria listed,
- weighting of the criteria
- assessment of the performance of the options on the criteria using a weighted sum over all the criteria for the options
- exploration of the 'balance' of the options on the major trade-offs
- improvement of the options through additional actions based on either poor balance or low performance on key criteria

A checklist is provided and from the PDD there should be sufficient information to inform the judgements required on the criteria. If this is not the case then the project participants and local representatives may have to be interviewed. As this type of small scale community project requires the participation of the local community to stand any chance of long term success then there should already be a good understanding of the local conditions and priorities.

Instructions

- The first check is whether the local people have been consulted about the project and have input to the project design.

- The project should then be assessed on the criteria and compared to the SQ and the benchmark. The criteria are grouped under the major trade offs.

- The balance between the major tradeoffs is then examined so that key actions can be recommended to balance the project and to improve it.

Table 5-5 Example Checklist

Project and baseline details

Project name	
Project location	
Type of project e.g. electricity supply	
Size of the project: If a programme or bundled project give the number of units and the individual size If an individual project give rated capacity and expected load factor (how much it would be used)	
Sector e.g. urban community	
Services supplied by project	
Project boundaries	
Baseline activities providing these services if any e.g. 3 stone stoves for cooking with woodfuel Please make clear what is being replaced by the project	
What will happen to the services being replaced by the project? I.e. some activities continue or cease?	
How are the energy requirements for the community supplied before and after the project?	
What proportion of the local population will be able to afford the services from the project?	
How has the project been implemented? How many meetings have taken place with the local community affected? How were the meetings conducted and who were represented?	
What actions did the local community require at the consultation phase?	Original report required
What actions additional to the minimum project requirements have actually been carried out by the project developers?	

Assessment Checklist

Criterion	Definition	Project Score	Status Quo Score	Benchmark project score	Weight
Natural Resource Conserv-ation		Zero is least preferred 100 is most preferred 50 means that the increase in preference in going from 50 to the most preferred is equivalent to the decrease in preference in going to least preferred			First of all identify most important criterion for each subset, assign weight 100 and then weight others relative to this eg half as important is 50. The weight depends on the difference between the top and bottom of the scale and how much you care about it. Then compare across all 100 weighted criteria to find most important and scale the rest accordingly
Food	The effect of the project on ability of the community to produce sufficient food or produce crops to sell or animal grazing in terms of eg irrigation, availability and degradation of				

	land. It can be expressed in terms of change in volumes or qualitatively				
forests	The effect of the project on forests as wood resource and natural product resource. This can be expressed in kgs wood conserved and amount of natural products conserved if available.				
habitats	The effect of the project on flora and fauna . What are the activities and effect of the activities? This criterion does not deal with the effect on wood supply from forests.				
land use change	The effect of the quality and quantity of land used for the project.				
air pollution	The effect of the project on air quality due to SOx, NOx,				

	particulates etc emissions. This is not effect on health of the community which is considered separately but effect on all ecosystems and consequent wider health effects external to the village. This criterion is more of a wider global effect eg brown cloud over Asia.				
GHG reduction	The effect of the project in terms of reductions in GHG emissions compared to baseline kg CO_2/a for crediting lifetime.				
water supply	The effect of the project on water supply for washing, drinking, and cooking, particularly its quality for the future. This can be expressed in				

	l/day if available or the effect on maintaining volume available and any contamination of the water supply. Consider the sources, quantity and possible contamination routes.				
Resource Depletion	This is the effect of the project on the depletion of resources required for its manufacture or operation				
Social and human					
marginal groups	What activities and capacity building associated with the project have affected the women, weak etc marginalised and given them a voice?				
wider base	The effect of the project in terms of the new external connections to information on other projects activities,				

	training and people able to help.				
social networks	The effect of the project on social networks in terms of institutions and families etc in the community. This can be expressed as e.g. number of new institutions, more social occasions.				
security	The effect of the project on crime prevention.				
jobs	The effect of the project on number and diversity of jobs and raising quality of jobs: no and type of job but in relation to a purpose.				
freed time	The quality of life effect of the project from freeing time from drudgery. It is up to the people what they do with the time.				
health	The effect of the project on local human health of				

	outdoor and indoor air pollution, preventing diseases, acute respiratory inhalation, burns, backache etc and provision of health services				
education	The effect of the project on opportunity to improve level of education 3Rs literacy, for all ages, women and children.				
skills	Effect on building up more and or new skills eg mechanical, management				
Financial and physical					
income generation	The effect of the project on income generation or trade activities from the project including access to markets. This is not same as jobs, It is about more opportunities to increase income as long as markets exist and access is possible				

	e.g. grow garlic , extend hours of opening etc have income from a new job. It relates to effect on number and diversity of jobs and raising quality of jobs.				
energy	The effect of provision by the project of a level of energy service on total energy needs of community ie does it bring people up the ladder to sufficient energy resource to meet their needs? This is an overall assessment of how the project contributes to their existing general need to increase access to energy services.				
affordability	Cost to the community of the service provided by the project as a percentage of income ie is the service provided an				

	economic burden or not? Can the poor have access?				
infrastructure	The effect of the project on infrastructure increases. The extra benefits delivered by a project e.g. for transport, water sanitation and shelter and health services				
dwelling	The effect of the project on shelter in terms of new houses or improved quality of houses and whose houses are improved.				
Supply chains	Effect of the project in stimulating **local supply chains** for spares, maintenance and manufacture.			-	-
Local equipment	Amount of **locally manufactured equipment**.				

Calculation of the performance of the projects

Assessment of options should then be carried out using a simple spreadsheet to calculate the weighted sums under the major trade offs to show the total performance and the balance in the options as well as the weaknesses and strengths.

Possible Assessment Outcomes

- A project may perform well and is balanced so that there is no problem with approval.

- If a project performs well but is not balanced then the table of additional actions can point up some improvements that can be incorporated into the project design before it is approved.

- If a project does not perform well then the table of additional actions may give ways in which the project weaknesses may be strengthened so that it can be approved.

- The project is very poor and should not be approved.

5.3 Comparison with MEND, SSN and SUSAC

The problem with the CDM projects is that there is no mechanism under the negotiated text to ensure that sustainability benefits are delivered as well as the emission reductions for GHG gases. It was considered by policymakers, probably correctly, that it was impossible to specify sustainability indicators in the text and they subsequently declared the issue as a matter of host country sovereignty.

Currently project developers must prepare a Project Design Document (PDD) which has to include host government approval for the project. This approval is not a problem as long as host countries have the capacity to make the judgements and undertake the negotiations required to ensure that they get the benefits that are needed.

There is no other place where sustainability benefits are considered. The PDD for large projects includes an EIA which to some extent implies auditing of environmental and social aspects but this is optional for a small scale set of projects.

The importance of the sustainability benefits and their delivery cannot be overestimated. For projects to run in the long term it is essential to have local country buy -in to the project so that it is maintained and kept running. If the sustainability benefits are neglected then this buy-in will not take place and the chances of long term reductions will be low. Thus we consider that the delivery of the sustainable benefits from the projects is actually essential to the future delivery of the GHG reductions. It is also essential to deliver clean technology which will help leapfrog the mistakes of the developed world and promote equity. From that point of view the sustainability aspect of the CDM should not be seen as an add-on, ad hoc affair but as an integral essential part of a CDM project.

One focus of this project is to help to develop tools to build the capacity in host countries to assess proposed projects and if necessary suggest improvements to them to ensure that the project will be successful in the long term. Our approach to sustainability assessment of projects is designed to be at the small-scale community project level and has the following components.

a) It considers the assessment of projects for their proposed sustainability benefits using a Sustainability assessment model (SAM) or a simplified procedure based on a set of criteria
b) It suggests improvements can take place for any project and gives key additional actions which could be incorporated into the project.
c) It encourages host country follow up so that the benefits are in fact delivered.
d) It is focussed purely on the sustainability aspects and other criteria for the projects in terms of costs or feasibility are not considered.

Other studies have examined the assessment of sustainable development from CDM projects; notably the South-South-North project, the MEND project and the ongoing SUSAC project. In the next section we discuss these studies in detail and compare them to our approach.

SSN

The SSN project (Thorne and Raubenheimer 2001) has proposed a methodology for appraising the suitability of candidate CDM projects in the energy sector. They have a series of criteria related to eligibility and additionality of the project, the sustainability and the feasibility including barriers to its implementation. This set is much more wide ranging than in our study and so we focus on the sustainability assessment.
The projects considered are mainly energy projects in South Africa, Indonesia and Brazil. The scale of the projects is both small and large scale. The criteria used in the SSN study however appear to be a mixture of macro level and micro level indicators. They include

- contribution to global climate change
- contribution to local environmental sustainability
- contribution to net employment generation
- contribution to the sustainability of the balance of payments
- contribution to macroeconomic sustainability
- cost effectiveness
- contribution to technological self reliance
- contribution to the sustainable use of natural resources

Not all these criteria are relevant to small scale projects at the community level but they encompass some of the issues treated by the criteria set proposed in our work particularly technology transfer, environmental impacts, GHG reductions, resource depletion, and employment. The SSN team use a rating scale -3 <0<+3 where 0 means no change. They have worked with developing country partners in rating their projects on the range of criteria. As far as we are aware they do not weight the criteria.

SUSAC

The SUSAC project is still ongoing and final results are not available. An early paper on 'ranking methodologies for sustainable development and CDM project checklists' provides an indication that the work is being carried out at the project level and is intended to be input to the CDM secretariat. It is intended that a list of criteria would be produced which have been ranked and that this list should be applied to projects. Checklists would be tailored for specific industrial sectors on the basis of expert opinion.

It should be noted that the weights on criteria should vary with the range of effect from the set of projects. For example if a set of projects had equal performance on effect on water quality, that criterion would drop out of the analysis in an MCA but here the rankings of the criteria are fixed.

The project developer would then assess the project on the criteria list and use a ranking method to indicate how well the project conforms to the criterion. Yes/ no answers or precise numbers are also possible if the workload would be too high with the rating method.

The next step would be submission of the checklist to the national body to identify which projects most closely conform to the SD priorities. Below a threshold for minimum contribution set by the government, projects would be rejected.

Evaluating the checklists using a national expert group was considered to be non transparent and Saaty's decision hierarchy method was unfortunately suggested as a way of handling the problem of scoring and weighting criteria. Decision analysts know Saaty's AHP method as being problematic. There can be rank reversal when adding new options to the analysis and it has no theoretical foundation among other problems. A critique of Saaty's AHP method is given in DETR (2000). The decision analysis MADA or MCA approach suggested in this report is a more appropriate methodology to use.

MEND

The MEND project had as one of its strands the alleviation of poverty. Criteria were generated from existing strategic level documents such as UNDP world development indicators and discussed with national steering groups. These groups then chose a set of indicators which were ranked high medium or low within the 4 countries, studied, Bangladesh, Sri Lanka, Ghana and Columbia. The indicator set was as follows

- income
- food security
- water
- sanitation
- housing
- employment
- energy
- education/skills
- health
- transport
- crime/security/peace
- social exclusion

These overlap with many of the issues raised in this study using the S-L approach though there are still several key indicators not covered. The ranking is subsequently used to assign weights to the criteria. The projects which are hypothetical projects are then scored on the criteria for

- Assured benefits
- Potential benefits if collateral assets are supplied.

Each benefit is assigned one point and this is multiplied by the weight on the ranking of the criterion and summed over all the criteria to give a total performance score. This arbitrary assessment method was then used to give indicative results about what sort of benefits could be expected from the hypothetical projects. A range of project types were assessed and their expected impact on poverty alleviation was evaluated. Different projects had different impacts and relative priorities varied with each country.

5.3.1 Conclusions

The value tree for the assessment using the SAM approach was derived through discussion about the Sustainable Livelihood approach as this addresses the community level of the project. Other approaches use macro criteria at a national level or even the millennium goals as a starting point which is not necessarily appropriate to these small projects. The comparison with the other studies above showed that our approach is

- properly grounded in theory and practice of decision analysis
- does not use arbitrary scales
- uses a comprehensive set of criteria which are based on the S-L approach and are tailored to the community projects
- does not judge projects only on total performance on criteria as this can be misleading
- examines the balance of the project on the major trade-offs
- allows the strengths and weaknesses to be explore for each option
- provides examples of actions which can be incorporated into the project design to mitigate weaknesses and improve balance in the projects.
- allows comparison with the Status Quo and Benchmark projects so that the relative preference for the option can be assessed
- assesses the project type and size, the implementation actions and the existing baseline situation as a whole

Our study therefore extends what has been carried out to date and applies a methodology which has a sound theoretical base and has been applied by a team member who is a practitioner in the field of decision analysis models with assessments from in country partners. It has been applied to real projects where we have gathered field data to see what benefits have actually been delivered by the projects. The purpose of our study is to provide help to host governments so that they can assess CDM projects and negotiate improvements so that the projects will deliver the benefits needed.

5.3.2 Future Work

To develop the approach so that it can be extensively applied we suggest that the following are required

- Further work on developing and testing the simplified procedure
- Further work on training for SAM

5.3.2.1 Small Scale Industrial projects

The evaluation process as described based on the sustainable livelihoods approach is not suitable for an industrial project. A different set of criteria will apply in terms of the sustainability of the project operations. Thus the projects for which SAM has not been designed are the Capacitors project in Ghana, the tea MHP and cement works in Kenya and the cement works and cogeneration in Tanzania.

We suggest that a different criteria set is appropriate for these projects and further studies could be undertaken on this aspect.

6 References

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Annex 3.1 Questionnaire for Sustainability data collection

Sustainability aspects data collection questionnaire

1. Introduction

About this form/questionnaire:

Please find below a brief explanation on the structure of the forms, and important guidelines about how to fill the form.

For each project, there are two cases on which we need data:

- **Baseline case**: this is a description of the most likely situation in the absence of the project. If without the project 'nothing new' would have happened, then you must describe the existing situation before the project started. However, it is also possible that in the absence of the project, the existing situation would not have remained unchanged. In that case, you need to describe the expected changes in the absence of the project (for example if a micro hydro scheme replaces a very old diesel generator which is almost falling apart, then this generator would have had to be replaced in the near future anyway, e.g. by a newer diesel generator or by 'nothing' if there was no money to replace the old generator)
- **Project case**: details about the project

This form has 2 main sections which need to be filled, both for the baseline case and for the project case;

- **A general description of the situation**
- **Sustainability data**

When you fill in the form, please bear in mind:

The more information you can provide, the better. A yes or no is not usually sufficient. If there are no quantitative answers available then please give qualitative information

Not all questions will necessarily apply to all project types

2. General

1. What is the name of the project and the community it serves?

2. What size is the community ; no of households and total population

3. Who initiated the project?

4. Any other aspects of the community relevant to the project

3. Sustainability Aspects

3.1 Dwelling:

3.1.1 Baseline

What material are the houses made of ?

What sort of facilities to the houses have? Eg sanitation, water, electricity etc

What type of houses and what sort of amenities exist in the houses?

3.1.2 Project

1. *What is the effect of the project on shelter for the community eg has it provided any new housing or enabled people to improve their housing?,*

2. *Has it displaced people from their home?*

3. *Has the project benefitted only those in good quality housing?*

4. *Has it affected the proportion of people who have good quality housing?*

5. *Is there any additional work required to the houses so that people can benefit form the project?*

3.2 Land Take

3.2.1 Baseline

What was the land used for before the project?
2. Who owned the land?

3.2.2 Project

1. What is the land take associated with the project? Amount, area

2. What was the quality of the land taken?

3. Who now owns the land?

3.3 Food and crops

3.3.1 Baseline

1. What was the food and or crop or animal production before the project?

2. What irrigation facilities existed before the project?

3.3.2 Project

1. What effect has the project had on the production of food eg has it changed the irrigation to the land? Please give the change in irrigation or change in crop production in terms of yield or change in type of crop

2. What has been the change in animal production.?

3. *Has the project produced waste which affects the food and crop production? Eg contamination?*

4. *What wastes are produced by the project and what is the quantity per year?*

5. How are the wastes treated?

3.4 Habitat

3.4.1 Baseline

1. *Are there any special characteristics of the area in terms of plants and animals which should be protected?*

2. *How sensitive is the area to change?*

3. *Are there any surveys of the area?*

3.4.2 Project

1. What is the effect of the project on habitats in the area for plants and animals eg does it affect a long stretch of the river bank , give details?

2. *Have you noticed any decline in populations of common species since the project? How large is the decline?*

3. *Has the project had an effect on protected species?*

4. Are there any surveys of the area since the project was carried out and if so please give details of where they can be obtained

5. Have any steps been taken to minimise erosion and if so please give details?

3.5 Forest

3.5.1 Baseline

1. What was the state of the forest resource before the project?

2. What was the area of the forest before the project?

3. What was the forest used for? Please give details

4. What were the stresses on the forest?

3.5.2 Project

1. What are the current stresses on the forest?

2. What is the effect of the project on forest resources eg does the project cause any adverse effects to the trees and the plants in the forest?

If so what are these effects and how large are they?

3. What is the change in forest area and or amount of natural products harvested?

4. Is the forest sustainably managed?

3.6 Water Supply

3.6.1 Baseline

1. What was the water sourc before the projecte? Eg river

2. How far was it from the community? In Km

3. How long did it take to get the family drinking cooking and washing water?

4. How was the water delivered to people ?

5. How much water was used by the average family per day?
6. What was the quality of the project before the project?

3.6.2 Project

1. What is the effect of the project on the water supply? Eg Does it affect the amount of water available for drinking cooking etc ?

If so what quantity of water is reduced or increased in l/day?

2. How much water is now used by the average family per day?

3. Does the project lead to any water contamination and if so what sort of contamination?

4. Does it use water in its operation and how much?

5. *What are The liquid wastes from the project? Types and quantities/y*

6. *Where are the wastes disposed of?*

7. *Is there any treatment of the wastes to minimise effect?*

8. *Are people downstream of the project affected? If so were they consulted ?*

9. *What has been the effect for those downstream of the project?*

3.7 GHG reductions

3.7.1 Baseline

1. *What provided the service before the project?*

2. What were the other technologies, methods considered before deciding on the project?

3. What level of service was provided? Eg no of kerosene lamps, no of meals,

4. Type of fuel used and Average Amount of fuel/electricity used Kg/day or year etc

5. Where did the fuel come from and how was it obtained?

3.7.2 Project

1. *What is the service provided by the project eg lighting?*

2. *What is the size of the service eg no of homes and no of bulbs or KWh or KJ?*

3. *What is the technology used, capacity and efficiency?*

4. *What fuel is used and amount eg Kg/y?*

5. *Where does the fuel come from and how is it obtained?*

3.8 Air Pollution

3.8.1 Baseline

1. *What were the air pollutants associated with the technology before the project?*

2.How much of the pollutants were emitted if known?

3. Who were exposed? Eg old , young, mothers, men?

4. *How many in a household were exposed?*

5. Was the pollution indoors or outdoors?

3.8.2 Project

1. Are there air pollution emissions associated with the project?

2. Which pollutants are emitted?

3. How much of each is emitted?

4. Who is exposed to the pollutants?

5. How many in a household are exposed?

6. Distance from the project to nearest residential area

7. Is the pollution indoors or outdoors?

3.9 Social Networks

Baseline

1. *What were the social institutions in the community before the project eg committees ?*

3.9.2 Project

1. What was the community involvement in the project?; Who owns the project?

2. How was the participation with the community managed?

3. Who manages the project?

4. Who collects the revenues?

5. Has the project strengthened the community?

6. Does the project enable more social activities?

7. Does the project enable more family activities?

3.10 Wider Base

3.10.1 Baseline

1. What were the wider contacts for the community before the project?

3.10.2 Project

1. Has the project enabled additional wider contacts to be made with other communities, organisations and national or international connections?

2. Has any policy or institution external to the project helped with the project?

3.11 Marginal Groups

3.11.1 Baseline

1. What are the main barriers preventing women and other vulnerable groups from participating in the community decisions?

2. Please describe the main vulnerable groups and their size before the project

3. How were women involved in the community before the project?

4. Were there any welfare measures for the poor in the community?

3.11.2 Project

1. Does the project create more opportunities for women or other vulnerable groups to influence community decisions?

2. Does the project enhance the status of women and other vulnerable groups? If so how?

3. Has the project helped the very poor in the community? How?

4. Are women involved in the critical decisions, feedback or training?

5. What is women's role in planning operation and management of project?

6. Are there any welfare measures for the poor in the community as a result of the project?

7. Other comments?

3.12 Security

3.12.1 Baseline

Any other relevant considerations?

3.12.2 Project

What effect has the project had on security in terms of crime prevention? Eg has there been a noticeable change in the number of criminal offences?

If so can you give the change in numbers of criminal offences?

Do you feel safer as a result of the project? –give details-

3.13 Skills

Effect on building up more and or new skills eg mechanical, management

3.13.1 Baseline

What was the existing skills base in the community? (e.g. if the project requires brick-laying, how many bricklayers did the community have)

3.13.2 Project

What skills have been transferred to local and other people as a result of the project?

How have these skills been transferred and how many people have benefited? E.g. was there training for the operation and maintenance/installation/manufacturing etc.? Have women been involved in training/management programs? Has there been adequate training? What further training is required?

3.14 Education

Effect on level of education 3Rs literacy, all ages,

3.14.1 Baseline

What was the existing level of numbers attending school? Eg all children in the village, all women to night classes, all men attend night classes?

What was the existing pass rate at school? Eg 50 % through final tests? 50 % go to higher education?

3.14.2 project

Has the number of people attending school increased. Please specify whether it is day or night school. Please give details in terms of men/women/girls/boys.

How has the project enhanced the level of education of the local community eg has the number of passes at the local school increased? What is the current pass rate (see baseline)

What educational opportunities have been created by the project?

Is there an increased awareness and knowledge taught in energy-technologies? Are there any limiting factors preventing the uptake of education opportunities?

3.15 Jobs

Effect on number and diversity of jobs and raising quality of jobs: number and type of jobs, local and regional.

3.15.1 Baseline

What sort of employment was there in the area? main types of jobs before the project? Was there full employment in the area? If not what % unemployment in the area?

3.15.2 Project

Are project technology components manufactured locally? What is imported?

How many direct jobs have been created by project during all stages of the project cycle? ie construction, operation, quality control, maintenance,

How many indirect jobs e.g. supplier industries?

What type of jobs have been created?

3.16 Health

Effect on human health indoor air pollution, preventing diseases, acute resp inhalation, burns, backache etc

3.16.1 Baseline

What were the existing main health problems in the area

What were the existing health infrastructures eg clinics etc

3.16.2 Project

What has been the effect of the project on health ? eg Are there benefits in terms of respiratory disease or burns or backache etc

Are there benefits from providing health infrastructure eg lighting or refrigeration for clinics

Please provide any numbers if possible

3.17 Time

Effect on freeing time from drudgery

3.17.1 Baseline

What activities were occupying time especially for women and children before the project?

What free time did women and children currently have (hours/day) before the project?

How was the free time used?

3.17.2 Project

Does the project save time for the community especially for women and children?

How does it do this?

How much time is freed up (hours per day)?

Whose time is freed ?

When is the free time available?

How is the free time now used?

3.18 Funds

Effect on ability to get access for community to appropriate funds

3.18.1 Baseline
Has the community been able to access funds in the past?

What have been the barriers?

3.18.2 Project
Has the project allowed other community developments to be considered for funding ?

How has it done this ? eg through external contacts or through increased status for the community etc?

What funds have been accessed and for what development?

3.19 Income Generation

Effect on income generation or trade activities from the project

3.19.1 Baseline
What was the level of average income in local currency?

Who was able to earn this income?

3.19.2 Project
Has the project increased the income to the community? What has been the change of income (% or amount), e.g. from new jobs, savings in fuel

What are income generating activities?

Who has been able to increase their income? How many people have increased their income, and by how much has their income been increased?

3.20 Economic Costs

Economic Cost to the community of the service provided by the project as a percentage of income ie burden or not

3.20.1 Baseline

What was the level of cost of the service before the project (in local currency)?

How many people in the community could not afford the services before the projects?

3.20.2 Project

What is the cost of the service to each household provided by the project to the community ? in local currency/month

What are the savings or increases in cost to each household from the project in terms of local currency?

What is the proportion of income spent on the service provided by the project?

Are there people in the community who cannot afford the service? If so, how many?

What income level is needed to afford the services provided by the project?

3.21 Infrastructure

Infrastructure increase : the extra benefits delivered by a project eg for transport, water sanitation and shelter and health services

3.21.1 Baseline

What was the infrastructure in the community before the project?

Describe in terms of:
Roads
Paths
Pipes
Buses
Clinics
other

3.21.2 Project

Does the project provide any additional infrastructure benefits eg extra paths, roads, shelter, transport?

3.22 Energy

Effect of the project on the energy needs of the community; ie does it bring them up the graph on energy resource?

3.22.1 Baseline

What were the main pre project sources of energy for the community?
Please list the activities requiring energy and the pre project use of resources to provide the energy eg wood or charcoal for cooking

How much of each source was used per day?

3.22.2 Project

What is the total provision of energy to the community in eg KWh from the project

What service(s) is/are provided?

How many households are served?

3.23 Shocks

Contribution to the robustness of the community to shocks through the balance and diversity of community resources to withstand changes in the environment

3.23.1 Baseline

As for energy use

3.23.2 Project

Does the project provide a new energy source to the community or use an existing source more efficiently?

What resources are saved by the project, human and natural?

Annex 3.2 Summary of Sustainability data collected for Ghana

Table : Sustainability data for Ghana

Baseline Case	**Appolonia Rural Energy And Environmental Project (Appolonia Biogas Plant)**	**MME/Spanish Off-Grid Solar PV Rural Electrification (Solar Home Systems-Kpasa)**	**Traditional Energy Unit Project (Nabari Wood Fuel Project)**	**Greencoal Project (Improved charcoal processing)**
Size is the community/population	200 households with an average of 10people in a household (E)	1,400 households and a population of 17,000.	About eighty-two (82) households and a population of two thousand five hundred (2500) people	744 households and a population of 3,460 people
Materials used for houses	Cement blocks and clay bricks	Cement blocks and clay bricks	Made of mud and roofed with thatch	Cement blocks roofed with aluminium sheets and a few of moulded clay and roofed with thatch.
Facilities in the houses	There are no facilities in the houses	There are no facilities in the houses	There are no facilities in the houses	Electricity
The use of land before the project	No activity on the land	No land was taken for the project	Farming activities	Storage of processed wood awaiting export
Ownership of the land	A native	N/A	The Tindanas-royal family	Swiss Lumber Company Ltd.
Food crop and animal production	Pepper, yam, corn, cattle, sheep and goat	Beans, yam, corn, cattle, sheep and goats	Maize, millet, guinea corn, Soya beans, groundnut, yam, cattle, sheep, goat, poultry, and guinea fowl.	Cocoa, oranges, cassava, plantain, palm fruits, cocoyam, maize, goats, cattle and sheep
Existing irrigation facility	No such facility	No such facility	No such facility	No such facility
State of the forest and area before the project	Thicket not forest. Quite large no estimates	Normal, typical of the savannah area	Being depleted	In a good state
The use and stresses on the forest.	Wood fuel for fire wood and charcoal	Wood fuel for fire wood and charcoal	Source of their woodfuel	N/A
Sources of water to the people	A stream and a pond	A river, wells and bore holes	Six hand-dug wells with only two working	4 boreholes and a river in the town

How long it took the people to obtain water.	30-45minutes to walk to and from the stream	10-60 minutes (E)	10-50 minutes (E)	30minutes.
Delivery method (Water)	As head loads	As head loads	As head loads	As head loads
Quantity and quality of water consumed	12 to 24 buckets of untreated water per month	20 buckets of untreated water per day/h'se hold	7-10 buckets untreated water per day	20big buckets of untreated water per day
Source of the service and the service provided	Kerosene lamps and dry cells batteries for torch lights for lighting	Kerosene lamps and dry cells batteries for torch lights for lighting	Use charcoal and fire wood for cooking kerosene for lighting	Traditional charcoal producing kiln
Type of fuel and consumption	60kg bag of charcoal a month and a bundle of about 30kg wood for two days (E)	18 gallons (81litres i.e.4.5*1.5*12) of kerosene	Fire wood-1.5kg/day/h'sehold, charcoal-1.5kg/day/h'sehold, & kerosene-0.22l/day/h'sehold.	**Charcoal and firewood**
Pollutant associated with energy sources	CO_2, CO, Carbon particulates, NOx and SOx	CO_2, CO, Carbon particulates, NOx and SOx	CO_2, CO, Carbon particulates, NOx and SOx	CO, PACs, which are harmful gases and incomplete combusted pyrolysis gases
Those at risk because of the pollutant	All the people in each household	All the people in each household	All the people in each household	Those involved in the activity
Nature of the pollution	Indoors and outdoors	Indoors and outdoors	Indoors and outdoors	Outdoors
Social institutions in the community	Christian and Moslem groups	Christian and Moslem groups and youth clubs	Moslem groups	6 first cycle schools, a vocational school and youth associations
Women participation in community decisions	They are involved in the decision making	They were not so much involved	They were not so much involved	They are involved in the decision making
Vulnerable group	The aged in the community and the children	Women and children	Women and children in general	The poor in the community
Existing skills base (type of employment in the community)	Farming, bricklaying and carpentry	Farmers, carpenters, bricklayers, and technicians	Farmers, local masons charcoal producers.	Masons, carpenters, few mechanics, tailors, hairdressers, seamstresses, teachers and farmers
Level of school attendance	All the children of school going age in the village attend school	Most children attend school. No night classes	174 children are in school	Over 80% of the children of school going age attend school
Level of employment	Not full employment	Not full employment	Full employment based on the above listed activities	Almost all the people are employed
Health problems of the community	The major one is malaria	The major ones are malaria and diarrhoea	Malaria and Diarrhoea.	Flu and fever and a few complicated cases associated with childbirth

Existing health infrastructure	Mobile services	The have two health centers	Mobile services.	A clinic
Activities that occupied the time of the women	Domestic and farm chores	Domestic and farm chores.	Domestic and farm chores	Domestic, trading and farm chores
The free time women and children have and what is used for	The farmers have little time where as the unemployed have the whole day to rest	Very little time during the day	During the dry seasons and mostly in the afternoon. It is used for resting since there is virtually no activity during this time.	The women make conscious effort to have free time otherwise there is none for them. They rest at these times.
The community's ability to access fund before the project	They have not been able to access any fund in the past	No	No	No
The barriers associated to their inability access funds	The effort was never made	The effort was never made	The District Assembly did not attend to their requests	N/A
Average income level in the community	250,000 cedis per month	Between ¢100,000 and ¢1,500,000 per month	¢98,000.00 per month	¢200,000 per month
Cost of service before the project	60kg of charcoal: ¢35,000 kerosene (gallon): ¢11,000.	Kerosene (gallon): ¢11,000. Fire wood obtained free from the farms	The woodfuel were obtained from the forest at no cost.	50kg of charcoal cost ¢12,000
Number of people who could afford the service	Almost all the inhabitant	Almost all the inhabitants	All the inhabitants	Almost all the inhabitant
Nature of roads	Not too bad	Not too bad	Not too bad	Not too good
Nature of path	Not too good	Not too good	Not too good	Not too good
Pipes	None existing	None existing	None existing	More needed
Buses	No buses	A few	None existing	Buses available
Clinics	No clinics	Two with limited drugs	Mobile services	One
Project Case				
The effect of the project on shelter	No effect on the shelter of the community	No effect on the shelter of the community	Added a structure to the existing ones	No effect on the shelter of the community
Those who have benefited from the project	Those who subscribed for it and were lucky benefited	Those who subscribed for it and were lucky benefited	The whole community would benefit	The individuals who would like to use the product
The land take and the quality of land associated with the project	About 5hectares	No land take associated with project	60 hectares but only five 5 hectares has been cultivated.	No farmland was taken. It occupies only a small area on the company's premises
Effect of project on crops and animal production	Positive effect on production	No effect	No effect	No effect
Waste associated with project	Effluent slurry. This is a high quality	No waste	No effect	Pyrolysis gas which is minimal

and treatment	organic fertilizer			hence no treatment
The effect of project on protected species and steps taken to check erosion	No effect	No effect	No adverse effect	No adverse effect
Stresses and effect of project on forest resources	No effect	No effect	The project will reduce the stress on the forest when harvesting starts.	Cutting down of the trees for wood products and sold as concessions to timber firms.
Change in forest area and its management	There has been no changes	No changes	Increase by five (5) hectares with about fifty-five more hectares to be added. It is sustainably managed	The project has not added to the forest area but rather making use of the waste wood that is burn in the open air.
The effect of project on water resources	No effect	No effect	No effect	No effect
Service provided by the project	Electricity for lighting	Electricity for lighting and to power radios and TVs	Woodfuel for cooking	Production of charcoal for cooking
Size of the service provided	5KVA and 7.5KVA generators provide electricity to 21 households, schools, churches and a mosque	300 50Wp panels and 100 100Wp panels	20 tons woodfuel and would increase to 240 tons/year	720 Tons/yr. The bulk exported.
Technology, capacity and efficiency	Biogas to generate electricity with the total capacity of 12.5KW	Solar PVS 5.5kwh/m^2/day and efficiency between 10% and 15%	Forest management	Carbonization Technology developed and employed by the CARBO Group-Dutch origin
Source of fuel and the quantity	Biogas plant	No fuel used	N/A	3,000litres and 6,000litres per month of gas oil
Pollution associated with the project and the quantity	There is none	There is none	There is none	Pyrolysis gas extremely low
Community involvement and how they were managed	They provided labour and were managed by the Assemblyman	Beneficiaries paid commitment fees and were managed by unit committee	They provided labour and were managed by TEU committee established	There was none
Revenue collection and project management	They make available diesel to the caretakers to run the generators. This is 20% of the fuel used	Three-member committee including a technician	District Assembly (DA) and the Forest Service.	The company collects and manages the revenue
Effect of the project on the community	The project has resulted in the springing up of small businesses as well as increasing social activities.	The project has resulted in increase in production and social activities, and springing	The community now has a center where they can gather to take decisions concerning their	The project has no effect on the community

		up of small businesses	community.	
Eternal factors that affect the project	There is none	None	Funds have been provided to manage the forest reserve.	The Carbo Group BV of Netherlands helped a lot.
Opportunities created by the project for women	Many of them now sell at night under the streetlight. This has increased their income .	Children can now do their homework at night. Women can now carry out their domestic duties without any difficulty.	Various women groups have been formed. E.g. beekeepers, rice producers, etc.	None
Beneficiaries of the project	Those who subscribed 21 house holds, 15 street lights a church and a mosque.	Those who subscribed	The whole community	Only a few local people
Effect of project on security	There is none	Not much	There has been no change	No effect on security
Transfer of skills to the community and the number of people who have benefited	Skills in running/operating/managing a biogas plant has been transferred to 3 individuals	Electrical skills in installation of Solar PV systems and maintenance as well	Afforestation and bush fire prevention	Skills in charcoal production has been transferred to 7 people
Involvement of women in the training program	Women were not involved	Women were not involved	Women were involved	Women were not involve
The quality of training that has been given	Not adequate. Most problems cannot be handled by care takers	Adequate training in installation and maintenance of the systems	Adequate training in wood lot establishment, fire prevention and marketing	There hasn't been adequate training
Effect of project on school attendance	No effect	Not much	No effect	No effect
Source of project component	Local	Imported	Seedlings produced locally. The computers and vehicles are imported.	Imported
The direct and indirect job that have been made available by the project	Three direct jobs and there are no indirect jobs	About 30 direct jobs. The women who sold under the street light where offered indirect jobs. No estimates.	N/A	7 individuals have been employed directly.
Impact of project on health	There is none	The provision of Vaccine refrigeration and medical services are now possible at night	There is none	There is none
Impact of the project on time	Not much	Not much	Not much	None
The effect of the project on other community development	There is none	They have been able to build a meat shop	They have been provided with solar home systems	There is none

Impact of project on income levels	Income levels has increased	Income levels have increased between 30 to 150%	Income has not increased much	There has been no increase
Cost of the service provided by the project	A gallon of petrol for 3-5 days	¢7,000 and ¢15,000 per month	At no cost	¢8,000 per bag
Savings made as a result of the project	There were some savings in the beginning but this is no longer the case	¢10,000 per month	This cannot be quantified	There is none
The number of people who can afford the service	Many of the people can not	40% of the people	Everyone can afford since it will be at no cost	Anyone who uses charcoal can afford it
Income level needed to afford the service	About ¢150,000 per month	¢200,000 per month	N/A	N/A
Additions of infrastructure by the project	There is none	There is none	A community center	There is none
The total energy provision from the project to the people	10KWel provided for 12 hours	Estimated at 200kWh per year	About 240 tons of woodfuel per year	720tons per year
The nature of the energy that was provided	A new source of energy	A new source energy	A new source energy	An improved method of charcoal production