The Republic of The Gambia
Office of the President, Energy Division

Renewable Energy Study for The Gambia

Social and Environmental Report

Prepared by:

Lahmeyer International September 2005

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Abbreviations

AfDB	African Development Bank
CSO	Civil society organisation
DOE	Division of Energy
GBA	Greater Banjul Area
GDP	Gross domestic product
GREC	Gambia Renewable Energy Centre
GTZ	German Agency for Technical Co-operation
HH	Household
IRR	Internal rate of return
kWh	kilowatt-hour
LI	Lahmeyer International
LPG	Liquefied Petroleum Gas
M&E	Monitoring and evaluation
MFP	Multi-functional platform
MW	megawatt
NAWEC	National Water and Electricity Company
NGO	Non-governmental organisation
OMVG	Organisation pour la Mise en Valeur du Fleuve Gambie
PV	Photovoltaic
RE	Renewable Energy
RETs	Renewable Energy Technologies
SESA	Social and environmental assessment
SPACO	Strategy for Poverty Alleviation Coordinating Office
TOE	Tons of Oil Equivalent
UNIDO	United Nations Industrial Development Organisation
UNDP	United Nations Development Programme
VDC	Village Development Committee
VISACA	Village-Initiated Savings and Credit Associations
W_p	peak-Watt

Measures and Currencies

Currency Equivalents of Gambian Dalasi (D)

Exchange rate	2000	2001	2002	2003	2004	2005
US dollar (US$)	14.9	16.9	23.4	31.0	29.5	27.5

Measures

1 kW	=	kilowatt	= 1,000 watts (W)
1 kJ	=	kilojoule	= 1,000 Joules (J)
1 MW	=	Megawatt	= 1,000 kilowatts (kW)
1 kWh	=	kilowatt-hour	= 1,0000 watt-hours
			= 3,600 kilojoules
1 GWh	=	Gigawatt hour	= 1 million kilowatt-hours
1 TOE	=	tons of oil equivalent	= 11.63 MWh

1 INTRODUCTION AND SUMMARY

Under funding of AfDB Lahmeyer International has been contracted by the Government of The Gambia, Office of the President, Energy Division to provide consulting services for the "Renewable Energy Study for The Gambia".

The study purpose is to develop and promote the use of renewable sources of energy in The Gambia, with particular emphasis on rural areas. The study further is meant to assist the Gambian authorities in preparing projects that will provide sufficient energy to the population and improve their access to social services such as education, health services and water supply. In consequence, the study is supposed to contribute to poverty reduction through the improvement of economic and social conditions of the population particularly in the rural areas. Finally, it is hoped the study will help stop the ongoing environmental degradation. A Master Plan will be prepared in order to outline how renewable energy technologies can best be utilised to fulfil the energy demands and how to develop the renewable energy sub-sector taking into account economic, financial, social and environmental criteria. More details on the Renewable Energy Study are given in chapter 2.

This social and environmental report presents:

1) An overview of potential renewable energy applications for urban areas in The Gambia
2) An overview of social and productive uses of renewable energy in rural areas
3) A framework for design, monitoring and evaluation of project outputs and social and environmental impacts

Chapter 2 provides an overview of the energy sector in The Gambia. Gambia has to import all the fossil fuels for direct use in households, transportation and the productive sectors as well as for power generation. This implies that the country is increasingly faced with a rising oil imports bill. Only 30% of the population, mainly the people that live in the Greater Banjul Area, have access to the electricity grid, which is often hampered by periodic power cuts.

Given this situation, the use of renewable energy technologies i.e. solar devices (solar water heaters or solar photovoltaic home systems) or grid-connected electricity production (wind turbines and biomass-based) will have a number of positive social and environmental impacts would result from the introduction of these technologies:

- The setting up of the necessary production and repair facilities will offer a new business opportunity for the private sector and enhance the skills of local technicians
- The reduction for the demand for oil-fired electrical power generation could have a remarkable impact on Gambia's balance of payments and making government resources available for urgent development needs

- The resulting savings in diesel consumption will have a positive impact on the global environment in terms of reduced greenhouse gas emissions.

Use of firewood predominates among rural communities and a very significant portion of urban dwellers. Considering the adverse environmental impact of over-exploitation of wood resources (in The Gambia as well as in neighbouring Senegal), this report presents the following recommendations regarding the traditional fuel sector:

- Maintain a broader spectrum of household fuels, e.g. by increasing access and reducing the cost of LPG as well as by promoting the use of alternative biomass fuels (briquettes made from carbonised groundnut residues) and by promoting the use of more efficient wood and charcoal stoves in urban areas. This is discussed in chapter 4.
- Promote sustainable forestry practices (participatory forest management, agro-forestry, community woodlots, plantations), as is discussed in chapter 6

Provision of electricity can play an important role in increasing the quality of basic health and education services as well as public uses, such as telecommunications and powering community centres. Obviously energy services are needed for lighting, for cooling and refrigeration, water heating and powering medical, computer and communication equipment. Similarly, electricity can increase the living and working conditions of rural staff (teachers, health workers, extension officers). More details can be found in chapter 4.

Over 70% of Gambia's labour force is engaged in subsistence farming of rain-fed crops. Farmers are often forced to produce for home consumption and sell surpluses at disappointing prices. Labour productivity, post-harvest and processing losses, soil fertility and marketing are bottlenecks to agricultural growth and productivity. It is no surprise then that groundnut farmers have by far the highest rate of poverty than any of the socio-economic groups in The Gambia. Associated with poverty is the availability and stability of food supply[1]. Given the fact that agriculture provides food and income to the majority of Gambian households, there is a need to increase food production to satisfy income sources and adding value by improved processing and storage of agricultural produce. Increasing farm production at competitive prices will require (possibly year-round) energy inputs.

Energy intervention can play a supporting role in the increase of farming productivity, small farmer extension services and agricultural commercialisation. This requires access to energy services in various forms, electricity or fuel for pumping, boiling, drying and to drive mechanical and electric equipment. The promotion of (affordable) commercial energy services (fuel and electricity) is expected to improve productivity through irrigation and increased mechanisation as well as to create additional non-farming jobs in the rural areas (see chapter 5).

Options include water pumping by solar or wind-powered devices for horticulture or even cash crop irrigation, ice-making using solar energy, solar dryers. Similarly, power will be a necessary ingredient in many off-farm activities (agro/food

[1] Currently, The Gambia imports 52% of its food needs, while 48% is produced locally

processing, welding, carpentry shops as well as retail and repair shops). The Division of Energy has proposed the use of the so-called Multi-Function Platforms (MFPs), as has been applied in Mali, in which electricity is made available for a range of productive uses (see Text Box 5-2), such as irrigation, killing, carpentry and repair shops. These platform could be powered by a diesel generator or by solar/wind hybrid systems.

Heat applications, such as cooking, and drying for food preservation are generally better met with a thermal technology than an electrical technology. Although electricity can be used to create heat, it is usually much more expensive than alternative technologies. Renewable thermal technologies include solar water heaters, solar cookers and solar driers.

While the technical feasibility of all these options has been proven, the issue of acceptance by the local populace and their social and financial feasibility would warrant a thorough analysis, based on participatory methods (discussed in Chapter 7). In a second phase a feasibility study and tender documents will be elaborated for a priority project to be implemented in the medium term. This report presents a framework of indicators for the analysis of socio-economic and environmental impacts. This framework can not only be used for monitoring and evaluation of the outputs and impacts of the project, but should be applied as well during project design as a tool to identify the socio-economic and environmental issues associated with the implementation of the specific projects in order to make suggestions for the final selection of projects (alternatives).

2 BACKGROUND TO THE PROJECT

2.1 General objectives and approach of the Renewable Energy Study

The main goal of the Renewable Energy Study is to develop and promote renewable sources of energy as an alternative to conventional and traditional sources of energy especially in the rural areas of the country.

Given the background of the above-mentioned overall study goal, the specific objectives of the study are to:

- Assess the renewable energy resources of the country,
- Prepare a master plan for the development of the country's renewable energy sub-sector,
- Formulate policies, strategies and the required institutional framework for the development of the renewable energy sub-sector,
- Prepare a feasibility study and tender documents for a priority project which can be implemented in the medium term

2.2 Objectives and approach of the social and environmental review

The purpose of the Social and Environmental Assessment (SESA) within this renewable energy study is to provide a baseline overview of prevailing environmental and social conditions and to assess beneficial and adverse effects which could be associated with the implementation of the renewable energy programme and projects. If these impacts are negative, it aims to determine means to reduce or avoid adverse impacts or to increase benefits.

The SESA will be according to the general guidelines of the African Development Bank (AfDB) and will have the following guiding principles:

- Early integration of environmental and social effects not only in the monitoring and evaluation stage, but already in the conceptual or planning stages of the programme and projects thereof to have a flexible planning process
- Focus on broader environmental and social issues rather than on site-specific impacts in order to resolve conflicts that cannot be addressed project by project.
- Comparison of alternative energy options to achieve realistic, socially beneficial and environmentally sound projects.

The SESA will be built as part of wider monitoring and evaluation framework that will have indicators to assess the project technical outputs as well as the environmental, social, economic, political-institutional impacts. In the second phase of the Renewable Energy Study, this framework will be used a tool for the:

- Assessment of socio-economic impacts, such as the social uses of energy (households and availability of infrastructure and services, such as clinics, schools, water supply), productive uses of energy (agriculture, small enterprises), socio-economic environment (employment, income-generation, gender, cultural environment)
- Analysis of environmental impacts (soil conditions, surface and groundwater, natural resources, land-use patterns, pollution)
- Analysis of various feasible options and the associated beneficial and adverse impacts, including the 'without project option', in order to provide a justification of the selected projects
- Summary of analysis undertaken to consult the groups affected by the project (stakeholders, including the beneficiaries)
- Description of the activities designed to measure the indicators of the framework of project outputs and impacts and preparation of an environmental and social management plan (ESMP)/monitoring and evaluation (M&E) plan.

3 THE ENERGY SECTOR AND STATUS OF RENEWABLE ENERGY IN THE GAMBIA

3.1 Brief country overview

The Gambia is a relatively small state with a total surface of only 11,300 km² located on the Western African coast. Totally surrounded by its neighbour Senegal, the Gambia is mainly formed by the shores of the Gambia River. In 2003, population amounts at 1.36 million and is growing at a rate of around 4% annually, including 1.7% from recent immigration from other West-African countries. For African standards, Gambia is highly urbanised with a prominent rural-urban migration (7% per annum; DOE, 2004) and with about 30% of the population living in the he Greater Banjul Area (GBA).

The population distribution, according to the last census of 2003, is as follows:

Census 2003	Population		Households		Persons / HH
Urban	686 090	50%	96 546	61%	7.1
Rural	674 568	50%	60 947	39%	11.1
TOTAL	*1 360 658*	*100%*	*157 493*	*100%*	

The Great Banjul Area (GBA), comprising Banjul City, Kanifing and Brikama, is where most urban population lives: 592 701 inhabitants (86 %) and 84 107 households (87%). This area concentrated 53% of all households in The Gambia, in 2003

The Gambia ranks among the poorest countries in the world with a gross national product (GNP) per capita of US$ 320 in 2000 and US$ 280 in 2004. During the 1990s, the Gambian economy has been relatively stable. Real economic growth was 5.5% in 2000, dropped to 3.2% in 2001-2002, but was 8.8% in 2003 and 8.6% in 2004. Inflation has varied over recent years from 0.2% (2000), 22% (2002), 17.6% (2003), dropping again to 8% (2004) and 7% (January 2005)[2]. Although the standard of living has hardly improved, the population has been the least affected by the HIV/AIDS epidemic in the region. The Gambia is very active in international programs to fight local poverty and enhance the infrastructure and the local industry. One of the major problems is, not unlike many other countries in Africa, is the energy supply (fuels and electricity) to rural regions as will be detailed further in this chapter.

The agriculture sector (including livestock and horticulture) in Gambia contributes 30% of the GDP and provides income, food and employment to about 70% of the labour force. The largest (in value terms) agricultural exports are groundnuts, fish,

[2] Based on data mentioned in EUEI (2003), DOE (2004) and Databank Research Group (www.databankgroup.com)

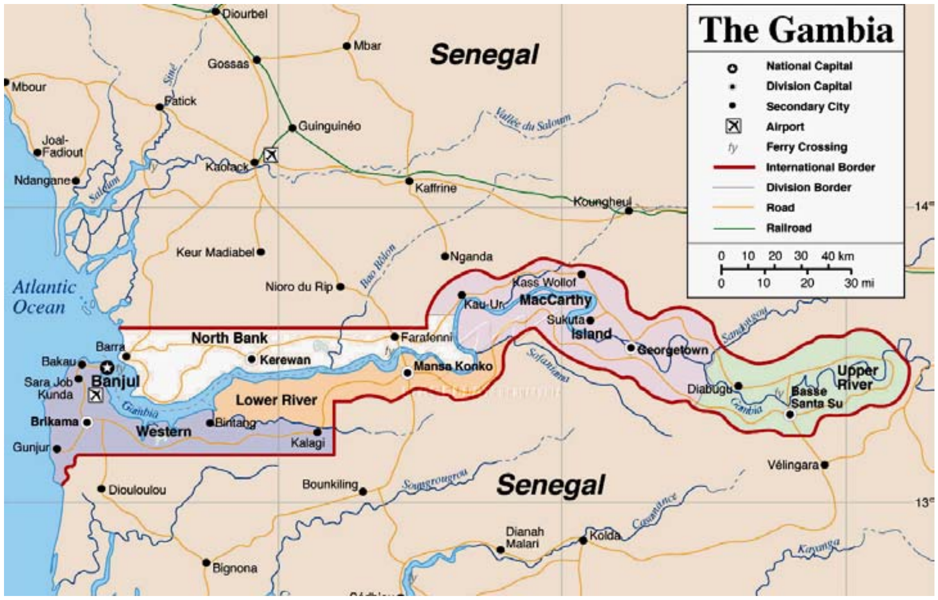

Figure 3-1: Map of The Gambia

groundnut oil, groundnut cake and cotton. The primary food crops produced are maize and rice. The primary meat products are beef and veal, chicken, game, lamb and pork. The total value of agricultural exports in 1998 was US$14 million, while the value of agricultural imports totalled US$ 96 million. Groundnuts account for 85-90% of expert earnings.

Outside agriculture, the Gambia has a rapidly growing tourism industry and a commercial sector, which is largely engaged in importing and re-exporting consumer goods to the neighbouring countries. The principal manufacturing activities is processing of groundnuts and few other modest resource based processing enterprises, mostly located in Greater Banjul Area (GBA). Fishing resources remain relatively under-exploited. Nonetheless, Gambia's small size, undiversified production base and open trade practices makes the economy highly vulnerable and susceptible to shortfall in agricultural production (e.g., declining groundnut production), shifts in the terms of trade (such as, prices of groundnuts and imported fossil fuels, fall in the value of the Dalasi) and external shocks (such as the 2002 draught). Trade and re-export are strongly influenced by trans-boundary-interactions with Senegal and sub-regional trade relations.

The climate of The Gambia is a Sudano-Sahelian type characterised by a rainy season (June to October) and a dry season (November to May). The average annual rainfall is about 900mm. Although there are indications of a reversal of the trend, there has been an average reduction of 27% in the annual average rainfall since 1951. The mean temperature is 25°C.

3.1.1 Electricity and fossil fuels

Energy balance and main issues

Energy consumption in 2001 amounted to 588 thousands tonnes of oil equivalent (TOE), of which wood fuels 82%, electric power 1%, petroleum products 16%, LPG 0.2% and renewable energy (solar) 0.02%. So far, there has not been found oil in onshore or offshore Gambia, neither natural gas has been discovered. The country has negligible hydropower potential within its borders[3]. All petroleum products (including diesel fuel for power generation) are imported and this signifies a substantial drain on the import-export balance[4]. Thus, Gambia relies on domestically produced and imported wood fuels and imported petroleum fuels. Its energy options remain limited in the face of increasing depletion of the wood resources (because of bush fires, farming, grazing activities and exploitation) and of the increasingly higher cost of imported petroleum products.

Electricity

In 2000, some 76 gigawatt-hours (GWh) of useful electricity were generated in The Gambia. Approximately 60% were consumed by residential consumers and small-scale industries, while hotels and larger industries consumed approximately 30% and the remaining 10% was by the public sector. Most electricity is consumed in the Greater Banjul Area (GBA).

The installed generation capacity is rated at 43 Megawatts (MW). Actually available capacity is only around 30 MW, of which 24 MW supplied by the National Water and Electricity Company's (NAWEC) Kotu power station and about 5 MW operated at Kotu by the independent power producer (IPP) GamPower. Peak power demand is said to be around 36-40 MW, but loading shedding in the order of 6 MW is a daily practice and some customers have only electricity 40% of the time. Hotels and businesses automatically start their backup diesel generators every evening during peak hours; a total in the order of 10 MW. NAWEC is planning to upgrade and expand the power grid by means of the addition of 18 MW

[3] The Gambia, Senegal, Guinea and Guinea-Bissau are members of the Gambia River Basin Development Organisation (OMVG - Organisation pour la Mise en Valeur du Fleuve Gambie) whose aim is to harness the energy of the Gambia River basin and the Konkouré River basin. The total energy available to the OMVG on all potential production sites is estimated at 1,440 gigawatt-hours (GWh) per annum. Currently the African Development Bank (AfDB) is conducting feasibility studies for the development of hydropower plants and interconnection of the power grids of these four countries. The first of the two large dams is in southern Senegal at River Gambia. The second dam is on the Konkouré River in central Guinea. The larger of the two projects is the Sambangalou dam, which will have a capacity of 50 MW and produce around 400 GWh of electricity per year. On the longer term, interconnecting the four countries into a larger West-African Power Pool (WAPP) would expand the access to large-scale power from hydropower and natural gas (from Nigeria). Despite these plans, there is little indication that the short-term outlook for electricity supply will significantly.

[4] In 1998, fossil fuel imports amounted to D 133 million (equivalent to 7% of total imports), while total exports only totalled D 171 million.

of generating capacity, which would in future not only enable The Gambia to meet its rising demand, but even to have some reserve capacity.

Currently, the average weighted electricity tariff of NAWEC in The Gambia is around D 5.0 to D 7.0 (or around US$ 0.20) per kWh[5] and thus relatively high in comparison to the neighbouring Senegal (US$ 0.12/kWh) and Mali (US$ 0.11/kWh). This average tariff is based on full cost recovery plus margin on service connections (LI, 2005a).

Strategies laid down for the electricity include the creation of a more conducive legal and regulatory framework, the formation of a partnership with the private sector and the participation of independent power producers (IPPs), increase the accessibility and supply reliability of electricity nation-wide, increase transmission and distribution efficiency and mitigate the environmental impact of the power sector.

Rural electrification

The electrification rate of the GBA and provinces averages below 30% (except for Banjul where the rate stands at 70%). According to a recent household energy survey (CDMI, 2005), 64% of urban users and 11% of rural users is connected to the grid[6]. Outside GBA only 6 provincial centres (Mansakonko, Farafenni, Kerewan, Janjangbureh, Bansang and Basse; see Table 3-1) have been electrified with a series of diesel-fired isolated systems with a total installed capacity of approximately 1 MW with electricity available for some 12-15 hours a day. In 2000, the total number of customers in rural areas was only about 2,600 out of a total of 36,000 customers[7].

The AfDB-finance Rural Electrification Project (currently in its implementation stage)[8], plans new power generation capacity (6.2 MW) the expansion of the transmission and distribution network to cover 30 more villages (in addition to the 16 existing villages) and increase power availability to 24 hours. When becoming fully operational, some 290,000 inhabitants would have access to regular power supply. It should be noted that this would still leave 60% of the population without access to electricity.

[5] In 2003, domestic tariffs range from D 1.55/kWh (consumption less than 40 kWh) to 2.88 (41-600 kWh), 3.15 (601-1000 kWh) and 3.9. The commercial tariff is D 3.9/kWh, while the agricultural tariff is 3.74 and hotels are charged D 4.3/kWh (EUIE, 2003). According to the DCMI (2005) survey, the average household expenditure in urban areas is estimated at about D 310 compared D 31in rural areas.

[6] 2.5% of urban households and 0.7% of rural households have their own generator, while 2% of rural households use solar PV; 1.7% and 2.6% of households use car batteries

[7] Electricity statistics compiled from DOE (2004), EUEI (2003) and S&WC (2000)

[8] The feasibility study was carried out by Lahmeyer International, which will also be responsible for supervision of the project implementation.

Table 3-1: Generation and network infrastructure in the Gambia

				MV-Transmission		
	Area served	Power Station	Capacity [kW]	33kV lines [km]	11kV lines [km]	No. of villages/ district towns
Urban						
	Greater Banjul Area	Kotu	43700	25	181	
	sum urban		43700			
Rural						
	Mansakonko		400			
	Farafenni		400			
	Kerewan		142			
	Janjangbureh		270			
	Bansang		420			
	Basse		640			
	sum rural		2272		15	16

Source: LI (2005a)

Petroleum products and LPG

The Gambia imports gasoline (11,550 metric tonnes in 2000), kerosene (12,455 tonnes), diesel (47,416 tonnes) and heavy fuel oil (24,708 tonnes). Main petroleum consuming sectors are transport, industry (construction) and power generation.

Current use of liquefied petroleum gas (LPG) is around 1,500 tonnes. The users almost exclusively belong to the high-income households of the society (85%) and hotel and restaurants (15%) as for them LPG is more convenient to use than firewood. For the lower strata, the use of LPG is not popular because too much capital outlay is required for investment in gas bottles, far exceeding the cost of a bundle of firewood (which is still relatively cheap). Over 56% of the urban households use LPG compared to only 21% of rural households (CMDI, 2005).

There are five companies that import LPG by truck-tankers from Senegal, namely Gam Gas, ELF, Shell, M&C and Touba Gas. The companies market LPG cylinders in the size of 3, 6, 12.5 up to 52 kg. In addition to the 1,500 tonnes of official LPG imports, unofficial importation of LPG is undertaken by small traders who buy small quantities of small-size cylinders (3kg and 6 kg) from Senegal, at a subsidised price, and sell them to the general public in The Gambia at the going prices fixed by the official importers.

The Government of The Gambia is active in attempting to replace ligneous fuels (firewood and charcoal) by petroleum products (LPG) and to some extent kerosene. LPG penetration is somewhat advancing in the Gambia, especially in GBA. The dissemination of the product nationwide is however hampered by the inadequate business and infrastructure (which implies relatively high import cost of inefficient and unreliable small quantities), low personal income of most consumers and high transportation cost.

There will be improvement in the import cost and availability of LP, when the planned Bonto LPG sea terminal (to be built by Mouchtara Holdings with a proposed storage of 2,200 tonnes to be supplied by ocean vessels) will become

Table 3-2: Prices of fuels and energy equivalent of cooking fuels

Fuel type *(early 2005)*	**Retail price** *(dalasi)*	**Fuel unit**	**Energy content** *(MJ / unit)*	**End-use efficiency**	**Energy cost** *(D/MJ)*
Cooking					
Fuelwood	1.2	kg	19.3	12%	0.52
Charcoal	3	kg	28.7	30%	0.35
LPG	25	kg	21.6	60%	1.93
Electricity	4.5	kWh	3.6	70%	1.79
Lighting					
Candles	1	piece			
Matches (box)	0.7	box			
Kerosene	28.7	litre			
Transport					
Gasoline	22	litre			
Diesel	21.5	litre			

Source: compiled from statistics, DOE (2004),

available. A feasibility study has calculated that the terminal (costing US$ 3 million) would lead to a fall in the import price of LPG of around 20% (EUIE, 2003). In addition, Mouchtara is considering employing a river barge with some 20 landing points along the Gambia River covering the entire country; when sailing the barge can refill LPG cylinders. The same study concludes that, in the longer run, the importation of only 7,000 tonnes of LPG has the potential saving of up to 80,000 tonnes of fuelwood. This initiative should trigger re-interest in LPG. An earlier attempt (supported by the European Commission) in the early eighties to introduce 30,000 LPG cylinders failed, due to a combination of managerial, administrative and institutional problems as well as the high price of LPG versus that of wood.

The cost of LPG was around 10-12 D/kg in 2003. To show the vulnerability to international price hikes, the price of a 12 kg cylinder currently on the market hiked from D 170 to D 300 in a matter of eight weeks in 2003 (EUIE, 2003).

Kerosene is used mainly for lighting by about 19% of urban households as compared to about 70% of rural households. The common types of kerosene appliances in use are wick lamp, tomato can lamp, hurricane lamp, and pressure lamp. These appliances have different capacities and duration of use per filling. Kerosene is retailed by cup, bottle and litre and households spend around D 1.8-2.0 per day (DCMI, 2005).

3.1.2 Traditional fuels

Traditional energy in The Gambia is synonymous with firewood, the bulk of which comes from the natural forest and savannah areas. The potential supply of firewood in The Gambia is finite and demand is much higher than supply, the deficit made up by wood fuel imports from Senegal. Present supply and demand are not exactly known, as no official statistics exist, but some estimates are given in this paragraph.

Demand and supply for firewood in The Gambia

Gambia is heavily dependent on wood fuels, mainly firewood. Fuelwood is the principal source of energy for 95% of the urban households and for rural households it is estimated that the firewood dependency is almost 100%. Reliable information on fuelwood consumption is scare, given the unreliability of the available data and because only a few surveys have been undertaken (that were limited in coverage and providing conflicting information).

These surveys give a rural per capita consumption of 0.54-2.96 kg per day and an urban consumption of 0.62-2.72 kg per day (DOE, 2004), as indicated in Table 3-3 below. A recent analysis of the underlying methodologies used in the survey concludes that the upper end of the estimates (Openshaw, Orgatec) is probably not correct as bundles of firewood were not actually weighed. On the other end, the changing situation in the 1980-90s (firewood price increases, introduction of improved stoves) may have had an influence on firewood consumption (Sallah, 2000).

Using the survey estimates of per capita wood consumption, it is not surprising that the estimates of total firewood consumption (equal to population size times the capita consumption) differ widely. Assuming an average annual per capita wood consumption of 1.76 m^3, the RPTES (1994) report estimated a figure of 485,000 tonnes of firewood that were used annually to meet the energy needs of 90% of the Gambian population in 1993. Of this amount some 60% was consumed in the rural areas. Taking into account that population has grown from 1.03 million (1993) to 1.36 million (2003) this implies a current annual fuelwood consumption of

Table 3-3 Per capita fuelwood consumption estimates

Survey title	Year	*in kg/capita/day* Rural	Urban
OPENSHAW	1972/73	2.96	2.72
ORGATEC	1981	1.6	1.80
VON BULOW	1982/83	0.73	1.00
COWI	1983	1.00	0.62
STEINER	1993/94	0.54	1.04
LAHMEYER	2005	1.13	1.28

Table 3-4 Demand for wood fuels in The Gambia

Sector/ Branch *(figures in tones per year)*	**Firewood**	**Charcoal**	**Sawdust**	**Total**
Household, urban	295 000	10 800	7700	367 500
Household, rural	279 000	2 300	100	292 900
Domestic total	574 000	13 100	7800	660 400
Hotel, Restaurants, Street-food	5 400	n. a.		
Bakeries	34 000			
Services total	*39 400*			*39 400*
Fish smoking	30 000			
Brick making	900			
Industries total	30 900			30 900
The Gambia	**644 300**	**13 100**	**7 800**	**730 700**

(kg per capita per day)	**Firewood**	**Charcoal**	**Sawdust**
Urban households	1.28	0.30	0.34
Rural households	1.13	0.19	0.49

Source: Lahmeyer (2005b)

around 700,000 tonnes, in line with the Lahmeyer estimate of 644,000 tonnes of firewood (LI, 2005b)

The services sector (hotels, restaurants, street vendors) is a relatively small consumer of wood fuels. Its aggregated annual consumption is probably in the order of 40 thousand tons of firewood, plus some hundred tons of charcoal.

Fish smoking industry processes about one half of all fish catch in the country, an estimated volume of 40 thousand ton/year. Specific consumption is in the order of 1.5 tons of firewood per ton of raw fish. So, fish smoking uses about 30 000 tons of firewood per year.

Fuelwood production and supply in rural areas

Around 70% of the population live in the rural areas. They obtain their fuelwood locally by means of collecting deadwood from farmland, fallowland, bush, or nearby forests. With the exception of the Central River Division, where fuel wood is collected and transported by men depending on their ethnic group, the collection of fuelwood is usually carried out by women and children (aged between 5 and 14 years), while men usually harvest bigger pieces of wood and transport the wood by head-loads and donkey carts.

Commercial fuelwood supply for urban centres

Unlike other countries in Africa, The Gambia has a unique set of forestry, administrative and marketing policies regarding wood fuels. Charcoal production is banned and the Law requires commercial woodcutters, to obtain licences. The number of exploitation licences is limited to 40 per district. The permit for each licence holder is inclusive of a maximum of three assistants that are authorized to collect deadwood from land within the Administrative Divisions they are located, (except from forest parks, community forests or from village lands that have a community license)[9]. The licenses allow the exploitation and production of five lorry loads per month each with a load of 10 tons, which amounts to 600 tons per year, but in practice only few producers are able to use the license to its full extent (Sallah, 2000)[10].

The fuelwood trade in The Gambia appears to be well organised. Four distinct actors are involved in the firewood industry. These are producers, market vendors, retailers and roadside producer/ vendor/ retailers, who each make a margin on the firewood, as indicated in Table 3-5**.** Fuelwood dealers, based in the urban areas, are responsible for most of the fuelwood brought in by truck. Small teams of fuelwood-cutters working for the dealers gather 10-ton truck loads of fuel in the forest area and then hire transport to take it to the Greater Banjul Areas (GBA) where it is distributed to local whole sale or retail dealers[11]. Fuelwood dealers operate under license and pay royalties to the Forestry Department and to local authorities.

Retail prices are substantially higher than wholesale prices, some 50 to 100% more in the case of firewood, and 30 to 50% more for charcoal. This is so because many consumers buy small quantities of fuel (four to five kilograms of firewood, or one to three kilograms of charcoal), usually the amount needed for one meal, and fuel retailers selling such small amounts apply a substantial margin of profit.

It should be noted that much of the trade in fuelwood may not be officially accounted for[12]. The Forestry Department, in cooperation with the Gambia Police, monitors the traffic in truckloads of fuel along the tarmac road leading into the GBA. The monitoring system appears to be working effectively and there is no evidence of large-scale evasion of the checking system by the transporters.

9 A licence holder must pay D500.00 for his licence and D250.00 for each of his three assistants. A wholesaler pays D500.00 for his licence and D200.00 per truckload.

10 The average time taken by the licence holders (and three assistants) to produce 40 m^3 (a lorry load of 10 ton) is noted to be 2 weeks. The production factor is 1:4, that is, for one m^3 of firewood sold in the urban areas, about 4 m^3 of wood is required. This rate is a rough estimate considering that forests are burnt to generate enough dead logs (Sallah, 2000). Commercial fuelwood production is usually done by men.

11 The trucks are owned by transporters and are usually hired while returning from a trip to distribute goods up country, thus providing an opportunity for low cost transport. The system appears to be competitive and provides customers with a reliable supply of wood at a moderate price

12 Since the license fee is only 4% of the cost, there will not be a noticeable price difference in formally or informally traded wood

Table 3-5 Price structure of fuelwood (in 2005)

	Producer	Wholesaler	Retailers (GBA)	Total
Licences/royalties/policy fees	2	8	1	5
Transport, loading, unloading	51	47	0	37
Labour and margin	47	6	19	20
Other (tools, association, rent)	0	5	4	4
Wood	0	34	76	35
Total	**100%**	**100%**	**100%**	**100%**
Total cost (%)	26%	51%	23%	
(price per tonne)	D 624	D 1835	D 2,380	

Source: adapted from LI (2005b) and research by Steiner in 1996 (DOE, 2004)

However, considerable amounts of small loads of the bundles of fuelwood are unrestrictedly brought into the GBA by pickup trucks and private cars.

The price of fuelwood to the consumer is, remarkably, constant at D5 per bundle outside the Greater Banjul Area and at D10 per bundle, in GBA and Brikama. These prices have remained constant and the Fuelwood Vendors Association (FVA) plays a key role in regulating prices. Wholesale prices are quite constant all around the country. The standard bundle of firewood, weighing 8.5 kg is sold at the roadside at a uniform price of 10 Dalasi in GBA and Brikama and D 5 per bundle outside GBA. Charcoal bags of 22 kg are priced between D 60 and 70 at the roadside.

Fuelwood in The Gambia has zero value at source. The cost to the consumer, therefore, only reflects the input needed to collect and process the wood, the cost of transport to the point of sale as well as the cost of the licence and royalties payable to Forestry Department. It is interesting to note that only 12% of the paid costs are rural income (apportioned to villages and rural labourers). No payments are made to the local communities in the areas from which wood is collected. Thus, the supply and distribution of firewood is mainly an urban business, and most of its added value remains in urban areas.

Charcoal

A few decades ago logging and extraction of firewood along The Gambia River was rampant. Large amounts of wood disappeared in the direction of Dakar, Senegal. For this reason the North Bank of The Gambia River is still significantly more denuded than the South Bank. The production and use of charcoal was banned in 1980, but this has been relaxed by the Forest Act of 1998 that make provisions for the import and sale of charcoal. Charcoal is mainly used for ironing and making tea or heating snacks on a small metal charcoal stove.

There are only few households using charcoal for cooking, although in reality there are no reliable statistics on charcoal consumption by households and food vendors.

Statistics kept by Forest Department register imports in the order of 700 tonnes per year. The RPTES (1994) reports estimates that around 21,000 tonnes of charcoal is imported from The Gambia informally, mainly from the Casamance area of southern Senegal. A recent Lahmeyer study on forestry (LI, 2005b) estimates that charcoal consumption is around 13,000 tonnes per year (see Table 3-4) with an unknown quantity informally produced in The Gambia, despite the official ban. An independent confirmation of this is given by a recent households survey (DMCI, 2005) in which 45% of rural charcoal users declared to be auto-producers.

Demand-supply balance on fuelwood in The Gambia

LI (2005b) makes an estimate of the maximum reasonable level of sustainable fuelwood production (under present forests conditions and current management practices) at round 203,000 tonnes per year. It is useful to compare this figure with the estimated rural (households) and urban (households, commerce) wood fuel consumption of 279,000 and 365,000 tonnes per year respectively (644,000 tonnes in total; see Table 3-4).These figures imply a gap between production and consumption of firewood of some 450,000 tonnes. Adding to this the wood-equivalent of charcoal, this leaves a gap of about 550,000 tonnes[13] of wood.

Although exact statistics are not available, it is thought that large part of the gap is filled by wood fuel imports, mostly originating from the Casamance area in southern Senegal. While most of this wood is purchased in bulk from Casamance and delivered in the Gambia by truck, some of it is transported across the border, by ox cart, to the main Basse-Brikama trunk road where it is collected by trucks. The LI (2005b) study estimates that 32% (208,000 tonnes per year) of fuelwood demand and 66% of charcoal demand (8,700 tonnes of charcoal per year) are imported.

Table 3-6 Estimate of potential for sustainable wood production

Source	Area (ha)	MAI (t/ha/a)	Utilization factor	Access factor	Annual net Availability	Share
Native forest, open access	400 000	0,56	0,70	0,50	78 400	39%
Native forest, community managed	42 000	1,20	0,70	0,90	31 752	16%
Agriculture with trees	86 000	0,30	0,90	0,90	20 898	10%
Agriculture without trees	260 000	0,15	0,90	0,90	31 590	16%
Fallow land	35 000	0,30	0,90	0,90	8 505	4%
Mangroves, closed	15 000	4,50	0,80	0,50	27 000	13%
Wood Plantations	1 500	7,50	0,40	1,00	4 500	2%
Agroforestry systems	n.a.	2,16	1,00	1,00	n.s.	
Village woodlots	n.a.	1,50	1,00	1,00	n.s.	
Total					**202 645**	**100%**

Source: LI (2005b). MAI: mean annual increment (in tonnes / hectares / annum)

This gives a balance of some 430,000 tonnes of firewood that are produced locally, in other words much more than the country can produce in a sustainable, thus depleting wood stock considerably. However, the RPTES (1994) study gives an estimate of commercial extraction of firewood is estimated to be some 180,000 tonnes per year more in line with the annual sustainable production estimate of 203,000 tonnes per year (LI, 2005b)

3.2 Renewable energy resources

Gambia possesses a renewable energy resource potential, based on solar, wind and biomass resources.

3.2.1 Solar and wind energy

The daily solar energy received is on average 5.4-6.0 kWh/m² (LI, 2005). As part of the Renewable Energy Study for the Office of the President, Lahmeyer will make a comprehensive solar energy resource assessment.

Given the low rural electrification coefficient, *solar photovoltaics (PV)* is one of the few ways to provide electricity supplies to remote rural areas, as will be discussed in more detail in the next chapters. The potential for tapping the solar energy resources for *solar water heating* was highlighted in the World Bank's "Solar Water Heating Retrofit" report (WB, 1985). The study analysed the costs and benefits of retrofitting diesel and electric hot water systems at five tourist hotels. The conclusion of the study was that at investment of US$ 400,000 (1983 dollars) in the solar water heating hardware and necessary system modifications in the five hotels would yield fuel savings of up to 350,000 litres of diesel annually and corresponding energy bill savings of between US$ 177,000-197,000 and internal rates of return between 44-49% (1983 figures). According to one informant, several hotels are using solar water heaters, while the Gambian Technical Training Institute has been involved in the design of solar water heaters.

Because of the capital required at installation, both solar PV and solar water heaters will be beyond the reach of poor households. A number of private firms are designing and selling solar powered electricity systems for domestic use and solar driven water pumps for communities. According to the Energy Division, some 640 kW of solar PV systems were installed in The Gambia in 2002, as compared to 240 kW in 1993 (DMCI, 2005)

The *wind energy* potential in Gambia is rather moderate. The World Wind Atlas gives an overview on the average wind speeds along the western coast of Africa in a height of 50m above ground and the map shows that average wind speeds between 5.5 metres per second at the coast and 3 metres per second inland. Although low, this potential could be sufficient for power production with modern wind energy converters or for water pumping, particularly along the coastline. As part of the Renewable Energy Study for the Office of the President, Lahmeyer International will make comprehensive measurements of wind speeds at 8 stations in The Gambia and make an assessment of its potential for energy supply.

3.2.2 Industrial biogas and waste-to-energy

In The Gambia, there are only a very few food processing factories that have an amount of organic residues worth mentioning. These factories are fish factories, slaughterhouses and beverage producing industry (LI, 2005c).

In The Gambia about 43,000 tonnes of fish per year are caught, of which 10,000 are processed in fish factories. The industrially processed fish is processed in 6 to 8 large factories as well as in some small factories. The two biggest factories produce about 12 tonnes fish per month. The residues are dumped in a landfill, but such a small amount of waste cannot be recommended for energetic conversion.

There are only small slaughterhouses in The Gambia. In Abuko, one of the bigger slaughterhouses, less than 50 head per day is slaughtered and this small amount is not interesting for a large-scale biogas plant. There is one energetically interesting brewery in The Gambia, the Banjul Breweries Ltd., where beer (JulBrew) and other refreshing drinks are produced. The amount of 3,000 – 3,500 m³ waste water can be treated anaerobically.

There are three landfills in The Gambia. The largest one is in Kanifing[14], the second largest is near Banjul and the smallest is in Brikama. The combustion of waste to extract biogas (referred to as landfill gas) is technically feasible but economically very risky. The sand in the waste would have to be separated and the total investment would be in the order of US$ 100 million. In March 2005, Italian investors met the Government in order to discuss the possibility of the construction of a 10 MW waste-to-energy power plant.

3.2.3 Biomass residues

The major food crops are groundnut, millet, sorghum, maize and rice. The main residues associated with these crops are groundnut fodder (hay), millet, maize and sorghum stalks and leaves and rice straws. Cotton is an important cash crop, leaving cotton stalks after harvesting. Not all residues would be available for briquetting. Only groundnuts, cotton and rice are processed at industrial sites. The other crops are basically subsistence crops that are processed locally. These cannot therefore be easily collected or have competing uses, such as animal fodder, fencing and as soil enhancer, leaving only small quantities for for the purpose of energy. One study (DCMI, 2005) has attempted to make an estimate of the national residue availability, discounting the requirements for the residues at farm level (see Table 3-7).

[14] In Kanifing the waste of 400,000 people is collected with a collection rate at about 50%. The total input material for the landfill is about 40,000 tonnes per year, consisting 60% of isand, 35% is organic material and 11% consists of paper or carton, while glass, wood, metals, textiles and rubber are below 10%. The total input material for the landfill at Banjul is about 20,000 tonnes per year. The collecting rate is 80% and 50% of the material is sand, 32% is organic material, while glass, wood, metals, textiles and rubber are together below 10%. Based on these data above the landfill gas potential in Kanifing is 21,000 gigajoules per year (TJ/a) and at Banjul 9,700 GJ/a.

Table 3-7 Estimates of agricultural residues availability in The Gambia

Crop	Cultivated Hectare	Grain Production	Residues Production	Waste remaining at Farm Level	Excess
Groundnuts	92,825	92,989	139,500 (hay)	*65,000*	*74,500*
			27,800 (shells)	*15,800*	*12,000*
Millet	76,374	78,464	156,900 (stalks)	*78,400*	*78,500*
Maize	12,872	18,177	54,600 (stalks/cob)	*32,800*	*31,500*
Sorghum	16,588	17,885	53,600 (stalks)	*32,100*	*31,500*
Rice	14,546	19,563	19,600 (straws)	*12,700*	*6,900*
			3,300 (husks)	*3,240*	*60*
Cotton	2,419	1,270	1,270 (stalks)	*0*	*1,270*
Total	*215,624*		*425,470*	*295,500*	*129,970*

Source: DCMI (2005); calculated from average 1994-2003 production statistics

There is a mushrooming of local sawmills processing a variety of wood into various timber products. A lot of waste in the form of wood dust and small cuttings are being generated on a reasonably large scale through this activity. There does not appear to be any major use for these by-products at the moment, except small quantities that are used to start cooking fires and some households use the sawdust waste to cook. The use of sawdust stoves is increasing due to the rising cost of fuelwood. Some 22% urban household uses biomass residues (half of them using sawdust, paying D0.39 for day use on average.) About 6% of rural households use biomass residues (DCMI, 2005)

Groundnut shells are already (partly) being used for power generation in the edible oil processing industry. The company Premier Agro Oil processes groundnuts for oil extraction. A new company, Gambia Marketing Company (GAMCO) entered the market in 2004. There are two main peanut factories in The Gambia. The one near Banjul is de-hulling about 30,000 tonnes of groundnuts annually under good circumstances. Another one at Kuntaur was at the time of investigation (May 2005, LI 2005c) not operating, but in better days it could process about the same amount. The company has fluidized-bed boilers to produce steam for the plant itself. Assuming a full harvest season yielding 60,000 tonnes of groundnuts[15], this would produce 18,000 tonnes of groundnut shells. The generation of the companies 1.5 MW boilers would require some 7,200-8,400 tonnes per year (EUIE, 2003).

15 Due to poor rains the annual groundnut production can be much less, e.g. totalled only 20,000 tonnes in 2002.

3.3 Institutional framework of the energy sector

3.3.1 Key organisations involved in energy and rural development

The management responsibilities for the energy sectors involve a number of agencies. The following summarizes the key institutions and their responsibilities:

- **Government and public sector**
  - The *Office of the President* is in charge of the overall energy portfolio. Its technical arm is the Energy Division.
    - The Division has a Director of Energy and a Commissioner for Petroleum. The Director of Energy is engaged in legal, policy, strategy and programme formulation as well as coordinating cross-cutting issues with other stakeholders in the energy sector (e.g., oil and LPG companies, renewable energy). The Director further serves as serves as desk officer for the public utility NAWEC (see further) and supervises the Gambia Renewable Energy Centre (GREC, a body responsible for research, development and utilisation of alternative energy resources).
    - The Commissioner supervises the upstream petroleum activities. The mandate of the office includes the promotion of the country's hydrocarbon potentials, negotiating the award of exploration and production licences, negotiating bilateral and multilateral cooperation agreements and developing policies and strategies to enhance the development of the industry.
  - The public enterprise *National Water Electricity Company (NAWEC)* operates the power supply, water and sewage services for the country, under the purview of the Office of the President. It is a vertically integrated company, responsible for the nation-wide generation, transmission and distribution of electricity. NAWEC is not operating on a commercial basis and cannot generate sufficient financial resources to maintain and upgrade the system. Although tariffs have been adjusted to cover cost, high transmission and distribution losses are common, a staggering 30-35% (due to lack of enforcement of tariff collection, adequate maintenance and aging facilities). To address these issues, the Government has embarked on a strategy of restructuring, consisting of (a) promoting private sector investment in power generation (independent power producers, of which the before-mentioned GamPower is the first example) alongside NAWEC (which would retain its vertical structure), (b) creation of agencies for the divesture (privatization) of public sector companies as well as multi-sector regulation (Public Utilities Regulatory Agency to regulate the private and public players in the electricity, petroleum and other relevant sectors)
  - The *Department of State for Fisheries and Water Resources* and the *Department of State for Forestry and the Environment* are responsible for the proper and efficient management of the nation's natural resources. Its

technical agencies are the Department of Water Resources (e.g., involved in water supply, using solar energy), Forestry Department, Department of Fisheries (both are relevant to the fuelwood issue) and Parks and Wildlife Management as well as the National Environment Agency (NEA, a main stakeholder in natural resources management and the environmental aspects associated with energy use (pollution, greenhouse gases). The Gambian-German Forestry Project has been working for the past 25 years on participatory forest management and forest protection, but was phased out during 2004

- Apart from being responsible for the management of the country's macro-economic framework, the *Department of State for Finance and Economic Affairs* is preoccupied with the flow of receipts to government. One of the main avenues of such inflows is taxes levied on imported goods and fossil fuel products importation.
- The technical arm of the *Department of State for Local Government and Lands*, the Department of Community Development, is responsible for community mobilization and has been engaged in promoting the efficient management of fuelwood resources through the promotion of substitutes (LPG, biomass briquettes and biogas) and improved stoves for firewood.
- Other government department, relevant to rural issues are the *Department of State for Education* and the *Department of State for Health and Social Welfare* (schools, clinics and social services) and the *Department of State for Agriculture* (in particular the Department of Agricultural Services).

- **Private sector and financial institutions**
  - The petroleum sector is effectively unregulated in the Gambia, except for the price formula for market stabilisation. The sector is largely self-regulated by the two major companies, ELF (now Total Fina ELF) and Shell, with regulatory oversight relying principally on the goodwill of both companies to conduct their activities according to high ethical and professional standards. Castle Oil and Elton Oil are two recent players in the petroleum sector
  - With respect to renewable energy, solar energy is in the market and a number of companies are operating in this field, including GamSolar, VM The Gambia Limited, Gambia Electrical Company, SWEGAM and Dabakh Malick Energy Centre.
  - Important commercial banks are the Trust Bank, Standard Chartered Bank and the Arab-Gambian Islamic Bank (AGIB). The importance of the banking sector for energy and development is limited. With prime and commercial interest rates of 31% and 36% respectively, most loans are for short-term trading purposes and not for development projects. The AGIB, being an Islamic bank, does not charge interest[16] and is involved in

[16] Although not charging interest, AGIB is allowed to loan money itself and pay interest

leasing of equipment (in which the bank purchases equipment, e.g. solar equipment, and provides the requesting company with the equipment, after which the company pays AGIB through a deferred-payment scheme). AGIB is also involved in skills development through its Enterprise Development Project. In this EDP craftsmen are trained in elementary management, provided with a start capital (an extra 20% above the cash needed for equipment) to set up their small enterprise (EUIE, 2003).

- **Institutes and civil society organisations (CSOs)**
  - *Research institutions and training centres*, include the Gambia Renewable Energy Centre (GREC), National Agriculture Research Institute (NARI), Forestry School, Gambia Technology Training Institute (GTTI), University of The Gambia, Gambia College
  - *Non-governmental organisations (NGOs).* The Association of NGOs (TANGO) was created as an umbrella organisation for NGOs and some 65 NGOs are now part of the TANGO network. TANGO and its members have been involved in environmental, reforestation and gender activities. With respect to energy, TANGO could play a role in awareness and education. Important NGOs working in the area of livelihood, micro credit, agricultural and horticulture improvement, health and skills development are ActionAid, Catholic Relief Service (CRS), Gambia Women's Finance Association (GAWFA), Social Development Fund (SDF), Concern Universal, Association of Farmers, Educators and Traders (AFET), Agency for the Development of Women and Children (ADWAC) and the Trust Agency for Rural Development (TARUD). It would be beyond the scope of this report to discuss all the NGOs working in The Gambia, but a list of NGOs (associated with TANGO) is given in Annex B. Micro-credit NGOs are regulated by the Central Bank of The Gambia. The Social Development Fund (SDF) was set up by the World Bank-funded Poverty Reduction Project, but other multilateral donors used this micro finance window as well to increase access to micro finance services to poor rural communities.
  - *Community-based organisations* exist mainly at village level, consisting of individuals in the communities that come together to manage and mobilise resources in a participatory way to improve the quality of life. One or more CBOs exist in virtually every village. CBOs can be engaged in various activities, e.g. by organising group farm work, promoting income-generating activities (e.g., small trading, sewing, soap-making) as well as savings and credit activities and vegetable gardening. Some CBOs are registered as societies that undertake registered savings and credit facilities (VISACAs, Village-Initiated Savings and Credit Associations). At ward and district level, community organisations exist that coordinate the various CBOs and act as liaison with development agencies, referred to as the Village Development Committees (VDCs). Many development agencies and NGOs actively support CBOs in community capacity

building, leadership and organisational training, skills-training, micro-finance and revolving funds.

3.3.2 Policy framework for energy-relevant issues

The country is developing well-defined policies and underlying intervention programmes (action plans) for the energy-related issues and options:

- Energy
  - National Energy Policy (2005, draft paper)[17]
  - Electricity Law (under review)
- Forestry
  - Forestry Act (1998) and Regulations (2000)
  - Forestry Policy 1995-2005
  - National Forestry Action Plan (2001)
- Environment
  - Environmental Action Plan I (1992)
  - Environmental Action Plan II (2002)
  - National Action Plan to Combat Desertification (2000)
- Poverty and rural development
  - Local Government Act (2002)
  - Interim Poverty Reduction Strategy Paper (under preparation)
  - National Education Policy (1988-2003)

Gambia has signed and ratified various international conventions related to natural resources:

- The Convention on Biological Diversity (CBD), ratified by Gambia in 1994. The Department of Parks and Wildlife Management is the focal point. Gambia signed the Cartagena Protocol in 2004.
- The United Nations Framework Convention on Climate Change (UNFCCC), ratified in 1994. Gambia signed the Kyoto Protocol of the UNFCCC in 2001, The Department of State for Fisheries and Water Resources acts as focal point for the Convention and the Kyoto Protocol.
- The United Nations Convention to Combat Desertification (CDD), ratified by Gambia in 1994. The Department of Forestry acts as focal point.

[17] Prepared by Stone and Webster Management Consultants (S&WC)

4 APPLICATION OF RENEWABLE ENERGY FOR SOCIAL USES

4.1 Description of households and rural infrastructure

4.1.1 Household characteristics

Households, income and poverty

Household sizes in both urban and rural sectors appear to be fairly comparable with the majority of households having between 5-15 persons. A household can vary from a one-person unit to large polygamous households that live together in a homestead. About 90-95% of the population is Muslim and the remaining 5% mainly Christian. In practice, African, Westerns and Arabo-Islamic cultural patterns co-exist, with the Arabo-Islamic culture prevailing since it is nearer to the traditional ways of living (extended family system, polygamy). The major ethnic group is the Mandinka (42%), Fula (18%) and Wolof (16%). With Islam being the common denominator, intermarriage among ethnic groups is not uncommon and most ethnic groups have the same communal life structure in which male dominance is common. In The Gambia, each village has an identifiable area of land that falls within the jurisdiction of its own headman (*alkalo*). The land is usually not legally registered. Families or individuals in a village establish claim over a piece of land by tracing their decent, more often patri-linearly to the first settlers. The *alkalo* has the authority to allocate land to compounds in the village. Any compound head has the right to clear unclaimed land within the village's jurisdiction.

Traditionally, men and women have different tasks in farming households. Women carry out an estimated 60-80% of all agricultural work. Women are often responsible for food production and processing, meal preparation, fetching water as well child care and sanitation, and often can spend more than 16 hours on domestic and other chores (SPACO, 2000). In most Gambian rural households, the male head has the responsibility for providing food for the family, although all able-bodied adults must contribute to subsistence crop production. In the farming system, which often incorporates rice production, women have traditionally been responsible for lowland rice production, while men concentrate on the upland crops. Women commonly own separate rice fields for personal cash income and men grow groundnut for the same reason.

A recent household poverty survey (SPACO, 2000) indicates that 47% of the population of The Gambian lives in poverty, 30% in extreme poverty. Poverty is mainly a rural phenomenon with about 50% of the rural population being poor. About 35% of rural households fall below the food poverty line, compared with 15% in urban areas and 4%in Greater Banjul. Rapid urbanization is leading to a danger of urban poverty. About 91%of the extremely poor and 72% of the poor are working in agriculture. Poor women are generally worse off than poor men. The geographical distribution of poverty is uneven, with poverty being highest in the

Table 4-1 Estimate of household cash incomes in 1998

Cash income (Dalasis)	Extremely poor	Poor	Non poor	Average
Agriculture, fisheries	1547	4951	4809	2740
Manufacturing	6268	11715	10366	9434
Construction	9203	10516	7939	9011
Transport	7490	12307	16380	13519
Business and finance	19975	7800	15258	14990
Social and other services	7279	8333	16760	12236
Average	*3441*	*8758*	*12322*	*7917*

Source: compiled from SPACO (2000). In 1998, 1 US$ = D 11

rural groundnut areas especially in the North Bank, Upper River and Lower River Division.

Monthly salary is the source of income for the majority of urban households, while sale of farm produce is the most important source of income for rural households. About 85% of households in the urban sector receive a monthly salary or pension as opposed to only 24% in the rural sector. Table 4-1 provides and overview of cash income estimates in 1998. Some care should be taken in interpreting these figures as regular cash income is only one source of income. Farming households will use large part of their production for household consumption and this will not appear in cash income statistics[18].

According to the 2004 household energy survey, household paid income may arise from a number of sources, including formal sector monthly salary (D 1,124 and D 3,209 per urban and rural household), pension payments (D 694 and D 284 respectively), informal sector income (D 10,125 and D 6,839 respectively), earning from seasonal work (D 5,575 and D 3,286 respectively) and remittances from absentee relatives (D 11,666 for urban and 4,368 for rural households[19].

Poverty is pervasive in the Gambia with distinct geographic (rural/urban) and occupational divide. Risks of being poor increase with household size, type of occupation, education level. Extremely poor are often groundnut farming households that have large household size, live in polygamous households and have little or no education. The survey found that gender does not play an important role; households headed by females are usually well to do. Evidence

18 DCMI (2005) gives the following estimates for average annual sales of produce for rural households: cereals D 17,251, groundnuts D 29,689, vegetables, D 5,253, fruits D 6,117, honey D 2,459, fish D 14,831, livestock trading D 8,192, dairy products D 6,459, fuelwood collection D 1,823

19 In 2004, 1 US$ = D 30. The reader should note that these figures cannot be added up, as a household can have one or more of these income sources. However, one can conclude the average annual wages are low; a waiter may earn US$ 300 a year, a teacher or police officer around US$ 700 and a senior civil servant around US$ 5,000, according to the Lonely Planet Guide on The Gambia.

also points to increasing poverty. In the ILO 1992 report on poverty some 34% of the population was classifieds as poor and 18% as extremely poor.

According to the 1998 poverty survey, generally households spend 66% of their cash income on food items (some D 15,000 annually on food)[20], while clothing receives next priority. Generally, households spend nearly five times as much on clothing than on education and health combined. The spending is financed by cash earnings (53%), inter-household transfers (28%, but for female-headed households this is 51%) and *osusu* (informal savings, 10%).

Housing and appliances

According to the household energy survey by DCMI (2005), the most widely owned energy-consuming appliances owned by more than 50% of the urban households are a radio/music set (86%), television (67%), cellular phone (58%), telephone (51%), refrigerator (50%) fan (49%) and video/DVD (40%) and LPG cooker (25%). The most widely owned energy-consuming appliances by more than 50% of rural households are a radio/music set (84%), kerosene lamp (63%) and cellular phone (25%).

Most urban people live in cement block house with corrugated iron roofs (40%) or self-contained house (30%) of households and mud blocks with corrugated iron roof of households (28%). The most widely form of ownership is own house with 71% of households living in own houses and only about 19% of households living in rented houses. In the rural areas people tend to live in mud block house with corrugated iron roof (63%) and 88% the households is owner of the house.

Perception of development and energy problems

The information on public opinion about the three most important developmental problems was collected on a list of eleven topical problems during the DCMI (2005) survey. These problems are unemployment, agriculture related problems, health-care-related problems, education-related problems, drinking water, water supply for agriculture, roads/public transport, deforestation, electricity supply problems, wood supply problems and labour shortages.

For urban households, the three most important problems mentioned were (a) drinking water (rated by 40% of the respondents, (b) electricity supply problem (28%) and (c) unemployment (18%). For rural households the four most important problems in the rural sector are (a) agriculture-related problems (28%) and water supply (25%) with health care related problems (19%) and electricity supply (16%) as the second and third most important problem.

Interestingly enough the critical household energy-related problems of deforestation and wood supply problems appeared to rate very lowly in both the urban and rural sectors in the household energy survey. The household energy

20 In 1998, the extremely poor spend 71% (D 11,000 annually), poor households 66% (D 17,500) and non-poor 62% (D 22,000) on food. The poorer the household, the more is spent on staple foods, such as rice and cereals, rather than on proteins or other food.

survey (CDMI, 2005) reveals the following observations about the perception of households about fuels:

- The most important desirable attribute of woodstoves from the perception of households is the cheapness of the appliance, although 40% of urban consumers complained about the expensiveness of the fuelwood;
- The desirable attributes include convenience of use, availability, and special uses such as brewing *attaya*, while the urban respondents stress scarcity and expensiveness
- The dominant perceptions among urban household about the desirable attributes of LPG are its convenience/simplicity of use, decency and its special uses such as attaya brewing. The most important undesirable attribute observed by about 60% of households is its potential dangerousness.

4.1.2 Infrastructure and services

Roads

Poor and inadequate transportation is one of the critical constraints to development in The Gambia. There are certain periods of the year when some communities experience isolation from major supply centres due to inaccessible road conditions. Such conditions are more frequent in the rainy season and do occur in both urban and rural sectors resulting in disruption of supply lines of essential commodities including household fuels. Rural roads are considered to have had the least investment, resulting in high transport cost for agricultural inputs and exports, higher commodity cost and reduced access to social services for the rural (poor) population.

Education and schools

The majority of household heads are illiterate although for every 10 households there is at least one household with a literate member at primary level (DCMI, 2005). The poverty study of SPACO (2000) indicates that 41% of children of the extremely poor, 54% of the poor and 61% of the non-poor of the corresponding age group (7-12 years) were enrolled in primary school with no big differences found between boys and girl enrolment. For junior secondary school (13-15 years), these percentages were 65%, 75% and 86% respectively. More interesting statistics reveals the literacy rate, defined as persons 15 years old can read and write a simple phrase in English; only 14% for the extremely poor, 32% for the poor and 40% for the non-poor. The cost of education was D 230, D 925 and D 2,750 for primary, junior secondary and senior secondary respectively; the SPACO (2000) survey showed that the poorer (and thus most likely coming from the rural areas), the less chance for schooling. Since Islamic schools (*madrassah)* cost less, these have gained in popularity; but also non-poor sometimes prefer these schools, especially for girls (for moral and religious reasons).

Water supply

Adequate availability of wholesome drinking water has important implications for overall household health and well-being. According to DCMI (2005), the two most important sources of drinking water in the urban sector are private connections (42%) and public standpipes (40%), while rural households rely on public wells and (46%), especially in larger villages, public standpipes (37%). Public wells can be open wells that are usually not covered, using rope and bucket as the lifting device, or covered wells with a pump. According to the poverty survey, the extremely poor tend to rely more on open wells (52%) and wells with a pump (65%), while non-poor tend to rely on private (73%) or public standpipes (46%).

Health and clinics

Under-nutrition and malnutrition are an important part of the complex problem of poverty, availability of medical services and safe drinking water and incidence of diseases. Many of the poorer households are relying on open wells, which can be source of water-borne diseases as the water is prone to contamination. The poverty survey (SPACO, 2000) indicates that many of the poor are unable to meet nutritional requirements both in qualitative and quantitative terms, especially during the months before the first harvest of food crops, known as 'hungry season'. A 1998 national anthropometrics study of children under five years of age conducted in the dry season indicated 17% stunting, 7% wasting and 17% underweight. Not surprisingly, infant mortality rates among poor rural households are quite high and well above the national average[21].

The public health service delivery system is three-tier-based on the primary health care strategy. Presently, services are provided by 3 hospitals, 36 health facilities at the secondary level and 492 health posts at the primary level. The public health system is complemented by 34 private and NGO-managed clinics. Although considerable progress has been made over the past decade, a lot more remains to be done. The Health Action Plan 1999-2003 mentions several constraining factors, such as lack of staff, poor staffing conditions (adequate housing, fuel, spare parts), and communication problems between the basic and village-level health facilities and the services at divisional and central level.

According to the Department of State for Health, between 60 to 80 per cent of the population at divisional level live within the catchment area of Village Health Services (VHS). About 90 per cent of the population live within the recommended distance (a radius of 7.5 km) of a health facility, while 80 percent lived less than one-hour travel time from a facility. This translates into 95 per cent and 85 percent of the urban and rural population respectively having access to health services (UNDP, 2000).

[21] Infant mortality rate is 84/1000 live births, 60% of which is attributable to malaria, diarrhoeal diseases and acute respiratory tract infections (source: DoSH webpage)

Micro credit

The main micro finance institutions are the Gambia Women's Finance Association, National Association of Co-operative Credit Unions of The Gambia (NACCUG) and the Visaca Promotion Centre. Village-inititated Savings and Credit Associations (VISACAs) have been organised as small rural banking establishments designed to provide banking services to small, scattered rural communities that cannot be serviced by the few commercial banks in the country. The above-mentioned NGOs provide financial services to rural communities through community-based micro-finance institutions

At the village level, communities have also organised savings and loans associations or *kafos* in order to educate their members in financial management, institute a savings culture among them, while protecting them from usurers who operate particularly during the "hungry season". Repayment rates on micro-finance loans are reported to be quite high. Despite these efforts, the majority of the poor do not have access to financial services, primarily because they lack the means to engage in income-generating activities.

4.2 Renewable energy alternatives for household and social uses

4.2.1 Fuelwood savings and substitution

Improved wood and charcoal stoves

Fuelwood continues to be the most important household energy source in The Gambia. About 93% of the urban households use firewood compared to 96% of the rural households (DMCI, 2005). The majority of urban households purchase their firewood whereas the majority of rural households collect their firewood from mainly open access forests. According to a recent household energy survey (DMCI, 2005), the distance to the source is less than 3 km for 68% of rural households and most rural families are able to collect the firewood they need at less than one hour walking distance. Regarding awareness, over 58% of urban households are aware of improved stoves compared to about 68% of rural households (CDMI, 2005), with only about 27% of urban households compared to 16% of rural households actually using an improved stove.

These findings of this survey strongly suggest that a situation of acute scarcity does not exist, at least in the majority of rural areas. There is no or limited commercialization of the fuels used for local consumption. In the DCMI survey, firewood supply ranked 9th out of ten main problems identified by urban population and 8th by rural people. Even where high-quality firewood is not available (such as the preferred *keno* species), rural people tend to rely on small or less popular species. Experience elsewhere suggests that, as long as the agricultural system remains productive, the locally available biomass resources can meet local cooking fuel needs on a continuing basis. Under these conditions, low-income families have

Table 4-2 Social and environmental impacts of renewable energy alternatives for household and social uses

Sector	Social and environmental objective	Proposed renewable energy intervention
Households	• Conservation of forest resources • Improve living conditions by provision of clean energy services for lighting, safe drinking water supply, a.o.	• Re-introduction of carbonised biomass residues as an alternative for charcoal (in urban areas) • Solar or wind energy systems for electricity supply and/or pumping systems for village water supply
Education	• Increase access to basic education • Improve teaching quality • Increase access to vocational training and skills development	• Solar PV or hybrid system for lighting and ICT applications
Health	• Provide a basic health service package (by means of community health participation and promotion, improved health management and information systems, strengthening of health services and better hygiene)	• Solar PV and/or small wind-powered battery chargers and/or hybrid systems for vaccine refrigeration, lighting and communication with other health centres • Solar water heating for hot water supply (natal care, operations, equipment sterilization)
Community	• Expansion of the telecommunications network (Gamtel and mobile providers)	• Solar PV and/or small wind-powered battery chargers for village-level lighting (street lighting, community centre) and telecommunications

no financial incentive to shift from the traditional three-stone fire to commercial fuels or to invest in energy-saving stoves.

A number of development agencies have been preoccupied with the search for improved firewood appliances. Key among these agencies is the Department of Community Development, which has an appropriate technology research, and development unit preoccupied with finding solutions to topical domestic technology needs such as firewood appliances and biogas. Currently there are about six improved firewood appliances in use. Some of them have gained acceptance[22], such as the *sinkiri kuto* (new cooking place with chimney) and the *furno nufflie* (metal stove with lining, available at D150). No detailed studies have been made on the performance of these efficient stoves and thus its impact on firewood

[22] The *sinkiri kuto* is used by 26% of urban and 10% of rural households; the *furno nufflie* is used by 35% of urban and 9% of rural households; three stones open fire is used by 24% of urban and 79% of rural households (DMCI, 2005). A new cheaper metal stove (with no ceramic lining) has entered the market, called the *waka*, costing around D 65.

consumption is not known. The three stones method is still the more frequent firewood method in rural areas and ranking second in urban households. The cited study did not record the penetration of improved charcoal stoves. According to what is offered in the markets (where the traditional types by far outnumber the improved ones), it is clear that charcoal stoves are only in the first phase of dissemination and do not have general acceptance.

Briquetting

Agricultural residues from the agro-processing industry (bagasse, groundnut shells) would be utilised as (domestic) cooking fuel or for industrial processes. Biomass residues could be used as substitutes to firewood and charcoal in urban areas, but will only be attractive to poor families if price and performance can compete with wood fuels. In the 1980s, a groundnut shell briquetting plant was built at Kaur. Unfortunately, the use of briquettes never caught on, because the briquettes were regarded as inconvenient and smoky[23]. Finally, the plant (with a production capacity of 10,000 tonnes) was closed. However, this negative image can be addressed by improving the product and the rising price of firewood and charcoal may people look for a cheap alternative.

Carbonization and briquetting would provide rural employment, depending on which option would be chosen. In the central enterprise option an existing company involved in groundnut processing, could also get involved in carbonising and briquetting the groundnut shells. In the small producer option, farmers would be involved in the carbonisation of biomass at village level and take the materials to a central place, owned by a registered cooperative producer organisation (in Gambia this could be the Federation of Agricultural Cooperative Societies) or owned by a private company[24]. From a rural development perspective this could be interesting. A study done by DMCI (2005), estimate costs of carbonised materials at about D 625 per tonne; assuming a total biomass availability of 180,000 tonnes that yields 45,000 tonnes of carbonised material, this would be equivalent to a transfer of D 35 million to the rural areas.

Biogas

The Gambia has a relatively small *biogas* generation potential. Both human and animal waste are utilised for biogas production. However, hardly any cattle are penned to facilitate collection of cow dung for biogas digesters, and there are only a few relatively small poultry farms with adequate excrement yield. Furthermore, rural people have no tradition handling dung and excrements. This militates against the acquisition of sufficient quantities of dung excrement to feed biogas digesters.

23 As groundnuts contain oily substances, a briquette made of groundnut shells will emit unacceptable levels of smoke, if not adequately carbonized.

24 Putting up small briquetting plants at village level could technically be an option, but is not likely to be cost-effective.

4.2.2 Renewable energy for community-based services

Power for health facilities, community centres and schools

Even at provincial centres, electricity is only partially available, not even 12 hours a day. At some of the smaller centres, a smaller diesel generator may be available at the local clinic, but in rural Gambia the supply of fuels and electricity supply is highly unreliable. In order to improve the living conditions in peri-urban and rural areas (and prevent further urban migration), essential social services need to be strengthened, by means of electrification of schools (lights, photocopiers, ICT equipment) and clinics (lights, refrigerators, medical equipment), either by extending the grid or by stand-alone solutions.

Failing reliable refrigeration, the potency of vaccines is lost. Vaccine refrigeration and ice-pack freezing are the best-known and most common applications of solar energy in rural health clinics. Electric lighting greatly improves accessibility and quality of (emergency) care at night. Also radio communication can greatly improve rural health care services, by providing full-time communication with medical back-up staff at the divisional or national health centres.

In remote rural villages, schools and other community centres (such as mosques) are often a focal point for the community, with great potential for the integration of community development and educational goals. Basic lighting in the evening can facilitate after-dark activities like community reunions, adult education, religious activities and festivities.

Remote and non-electrified rural communities have notorious difficulty to recruit and keep trained medical and teaching staff. Small renewable energy systems (solar PV or wind turbine battery chargers) providing light, music, TV and communication can be important incentives for professional staff to stay. Also it allows teachers to prepare classes at night and stay informed, through radio and TV, which should have their effect on the quality of classes.

In The Gambia, powering public and community facilities has been supported by the European Commision (EC). Under the Regional Solar Program (RSP), 57 small solar community systems were installed with a total capacity of 104 kW_p (including refrigerators and community lighting). Many more PV installations in health and veterinary clinics have been successfully implemented through various donor-assisted projects. A small hybrid PV-diesel hybrid system was commissioned in 2004 for supplying electricity to the Darsilami small health centre, around 40 km south of Banjul.

Another type of renewable technology that could find increased communal application is the battery charging station, powered by solar or wind energy. Rural inhabitants come to the station to charge car batteries for TV and a light at home. In other African countries, such as Kenya, experience has shown that the gradual improvement in the battery system at home (improved light fixtures, charge control) often result in the acquisition of a small solar panel on the longer term. However, from an environmental point of view, the more widespread use of car or solar batteries should go hand-in-hand with a recycling system for batteries, to avoid that the batteries chemicals will be dumped into the environment.

World-wide, telecommunication makes up a large share of the market for solar PV panels. Continuing advances in radio and especially mobile telephone communications have considerably lowered investments in support infrastructure, especially for remote, hilly and otherwise inaccessible areas. PV is by far the preferred and most reliable power source for most remote telecommunication infrastructure. Single radio-connections and mobile phones can be run on small solar panels (10 to 50 W_p). The reliability and easy maintenance of PV systems also makes these services more reliable. The national phone company GAMTEL uses solar PV to power repeater stations and exchanges as well as rural pay phones.

Water supply

As discussed earlier in this report, the supply of drinking water is often a top priority of villagers that lack reliable service. The successful introduction of water supply (powered by renewable energy) to rural households should be continued as it will free, above all, the poor from daily drudgery in the fetching of safe water.

A typical installation has a dynamic head of some 40 m and pumps 180 m^3 per day with a PV Array size of 3,000 Wp. Although solar PV and wind pumping has proven itself both from technical and even economical point of view, several of the same barriers exist as for other renewable energy applications, including high initial investment cost and lack of infrastructure for maintenance, which increases costs and hampers reliable operation.

Major lessons can be learnt from the many PV pumping projects in the region. For example, a major PV pumping project in the Sahel region (Programme Regional Solaire - financed by the European Union), installed more than 1,000 pumping systems (1.3 MWp) in the early 1990s. Here, the lack of funds for operation and maintenance has been a problem and one lesson learnt is the importance of organization and financing of system maintenance by means of payment for water by the villagers. Before, collections were made on an annual basis to cover the operational costs and maintenance of these PV Systems. In the future maintenance funds for system maintenance and repair as well as operational costs will be created through actual water sales at a cost in the order of D 1.75/m^3 (EUIE, 2003).

In The Gambia, the solar PV Water pumping systems have proven to be rather popular compared to diesel powered water supplies. Although costlier than diesel-powered pumps, solar pumping systems are more reliable and easier to operate; once installed the PV systems do not require much and regular funding whereas the diesel powered units do obviously not operate without diesel. It has often happened that, when no fuel was purchased (and no water pumped), the systems were not maintained well and rapidly falling into disarray.

Box 4-1 GAM-Solar, an example of a renewable energy business in The Gambia

GAM-Solar Energy & Engineering Co. Ltd. is a renewable energy and engineering company based in The Gambia, dedicated to the promotion and marketing of clean energy technologies including solar home systems (ranging in the size from 12 to 120 W_p), solar water heaters, solar pumps and energy efficient light bulbs.

The American-based NGO E+Co supported GAM-Solar in 1999 with a $30,000 loan for the preparation of a business plan and $125,000 in equity for working capital to implement a solar home 8 village pilot projects. In May 2001, E+Co approved an additional $30,000 loan to GAM-Solar to purchase equipment. Furthermore, GAM Solar has been involved. GAM Solar has also been involved in the EC-supported solar energy projects, mentioned in the main text, in providing energy for 49 villages, will be involved in the JICA-supported project of providing solar-based power for another 30 villages. A project idea is under discussion with the US Export-Import Bank and the Government to provide solar energy for 20,000 households (solar home systems, street lighting and water pumping)

As a result of these pilot projects, GAM-Solar's new business strategy is the implementation of a solar energy and electrical lighting efficiency for households and businesses, schools, clinics and centres (such as mosques) in rural areas with electricity through the installation of solar (SHS) and portable PV lanterns, both through cash sales and short-term credit. Credit is offered to qualified organisations, including the Village Development Committees (VDCs), Teacher's Credit Union and other credit unions, NGOs and employers that can make periodic deductions from their members or employees salaries. GAM-Solar is also considering providing a line of income-generation equipment tied to solar energy sources to these organisations.

The EDF-supported Village Water Supply and the Regional Solar Programme (RSP) projects have provided some 50 solar PV pumping units in a first phase and another 26 systems in the second phase, totalling 112 kW_p (peak kilowatts) to be followed by another 20 systems (with 60 kW_p) during 2004-2006, while JICA has committed itself to another 60 kW_p (29 systems). The UNDP-supported Water and Sanitation project installed 10 solar pumping systems with a capacity of 20 kW_p.

In total, currently some 110 solar-powered systems (with borehole and tank of 50-100 m^3) are installed as well as some 1,850 lined wells with hand pumps (EUIE, 2003; DoWR: p.c.)

<u>Wind energy</u>

A company in Brikama makes small wind pumping systems (see photo on the cover page of this report), costing around US$ 300-500. The company also import small generators for battery charging.

5 APPLICATION OF RENEWABLE ENERGY FOR PRODUCTIVE USES

5.1 Description of agriculture and farming system

Crop production

About 314,800 hectares were under cultivation. These major crops are groundnut, millet, sorghum, maize and rice (284,800 ha):

- *Groundnuts* form part of Gambia's culture and is both a food and cash crop. The area under groundnut cultivation is around 45% of the total cultivated area. Current annual average yield is around 1 tonne per hectare, which with the correct application of fertilizer could be increased to 1.5 to 2 tonnes.
- *Millet* is the main subsistence crop with some 70,000-100,000 ha under cultivation for the two millet varieties, the early and the late variety. The excess production is traded locally by the farmers.
- *Maize* and *sorghum* are two other important subsistence food with some 40,000 ha under cultivation.
- *Rice* is a staple food for most households. In the past decade vigorous efforts are being made to increase rice production and productivity and the area under cultivation has been increasing steadily. There are two types, upland and swamp rice. With increasing incidences of short rainfall cycles in the country and the introduction of high yielding upland varieties such as "Nerica", the production of upland rice is increasing rapidly.
- *Cotton* is a cash crop that is grown in the upper part of the country, but there seems to be a declining trend in its production over the period 1992-2003.

On average, farmers sell about 70% of their groundnut harvest[25], compared to 11% for upland rice and 3% for the cereal crops (maize, millet, sorghum). The poverty survey (SPACO, 2000) gives a mean value of crop production in 1998 of extremely poor, poor and non-poor farming households of D 5,300, D 4,800 and D 11,700 respectively.

Traditionally, the rural areas have a well-defined, though not necessarily rigid, gender division of labour. Women are primarily engaged in lowland crop production (e.g., rice is mainly produced by females) and men dominate upland crops (where cereals dominate). Women tend to become more involved in groundnut production, while men are increasingly participating in irrigated rice production (DOSA, 2000; SPACO, 2000). Practices may also differ per tribe[26].

[25] The remainder is retained for homestead consumption, seeds and small local sales

[26] Mandinka, Fula, Wolof, Jola, Serahule and others

Table 5-1 Summary of crop statistics for The Gambia

	1998	2000	2003	2003	
Millet					
- area planted (ha)	73,300	90,400	109,900	- % of holders involved	83%
- total production (tonnes)	64,700	94,600	120,300	- area planted per holder (ha)	1.62
- producer price (D/kg)	2.87	1,64	7.65	- production per holder (kg)	1,772
Maize					
- area planted (ha)	11,700	14,800	21,000	- % of holders involved	72%
- total production (tonnes)	13,000	22,000	33,400	- area planted per holder (ha)	0.36
- producer price (D/kg)	3.16	1.72	7.65	- production per holder (kg)	566
Sorghum					
- area planted (ha)	14,200	24,400	24,700	- % of holders involved	26%
- total production (tonnes)	9,900	25,000	30,100	- area planted per holder (ha)	1.16
- producer price (D/kg)	2.90	1.65	7.60	- production per holder (kg)	1939
Rice					
- area planted (ha)	18,300	16,700	15,500	- % of holders involved	43%
- total production (tonnes)	18,800	34,100	18,013	- area planted per holder (ha)	0.44
- producer price (D/kg)	1.75	1.75	7.4-8.4	- production per holder (kg)	512
Irrigated rice	Included in rice statistics				
- area planted (ha)			2,300	- % of holders involved	
- total production (tonnes)			11,500	- area planted per holder (ha)	
- producer price (D/kg)				- production per holder (kg)	
Groundnuts					
- area planted (ha)	75,300	124,800	107,900	- % of holders involved	82%
- total production (tonnes)	73,500	138,000	92,900	- area planted per holder (ha)	1.61
- producer price (D)	2.79	2.6	7.50	- production per holder (kg)	1,383
Cotton					
- area planted (ha)	2,399	763	1,861	- % of holders involved	
- total production (tonnes)	474	238	476	- area planted per holder (ha)	
- producer price (D)	3.4	3.75		- production per holder (kg)	

Compiled from DOSA (2003). Total number of farming households was 82,278 in 2003 and total crop area under cultivation was 284,790 ha

Land tenure in Gambia is usually communal ownership and is governed by complex customary law. Land cannot be sold, rented or pledged for loan, except for transfer of the users' right to the land. Usually the village head of a village is responsible for distributing land. Consequently, there is no clear relation between poverty and land ownership.

<u>Livestock</u>

With a cattle population of 360,000 heads and a small ruminant population of 196,000 sheep and 304,000 goats, livestock provides an important source of food and farm income but also constitutes a serious source of pressure on the natural resource base. Livestock constitutes an important source of readily available disposable household income, means of both urban and rural transportation especially for fuelwood and important source of farm power. Its ownership guarantees a reliable fallback income source for emergency household cash needs. It is interesting to note that, according to the DOSA (2004) statistics, only some 30-60% of households own livestock; especially the non-poor farming households will own livestock. In interpreting these types of statistics, it is worth noting that cattle are generally kept in herds in which several owners pool animals

Table 5-2 Summary of farming practice characteristics

	% of households involved	Characteristics
Crop production	92%	See table 5-1
Livestock	87%	Total number of cattle is 363,000 (held by 38%), sheep 196,000 (held by 41%), goats 304,500 (held by 57%) and 600,000 chicken (held by 78%), pigs 24,0000 (held by 4%) as well as 34,000 horses/donkeys
Tree crops	82%	Most common crops grown include paw-paw, banana, guava, oranges and mangos
Horticulture	92%	Common vegetables are tomatoes, okra, peppers, onions, pumpkins and melons
Draught power used		On 95% of crop fields draught animals are used to plough fields (of which 30% oxen, 32% horses and 34% donkeys). In 2/3 of the cases the animals are owned in 1/3 have to be hired
Tools		Most common tools are hoe, cutlass, axe, plough, harrow, weeder and seeder for planting and groundnuts lifters and carts for harvesting. Mechanical power is are (tractors are used on 2% of the fields, electric motors, power tillers and threshing equipment is hardly used.
Source of income		Food crops (38% of households), cash crops (49%), livestock sale and products (35%), wage (17%), remittance from outside (20%)
Credit support	32%	Of which 2/3 receive credit in cash and 1/3 in-kind
Membership		VISACA (13%), GAWFA (19%), NAWFA (6%), NGOs (15%), SGA (9%)and other
TOTAL	82,278 (100%)	

Source: compiled from DOSA (2003)

together. Draught animals, such as oxen, are usually owned, mostly be the men, while women tend to be in charge of ruminants and poultry.

<u>Determinants of agricultural production</u>

Agricultural activities in The Gambia are influenced by several factors:-

- *Weather.* The Gambia being in the Sahelian zone of West Africa suffers from erratic and unpredictable weather pattern. There are years with low precipitation and years with relatively good precipitation. These conditions can negatively or positively affect agricultural production and productivity for all crops. Rainfall amounts vary between 600 to over 1000 mm. Farmers often adopt, so whenever there is persistent low precipitation, farmers tend to grow crops with short maturity cycle, for example by using the 90-day cycle groundnut (73/33) variety, instead of the 120-day cycle variety (28/206).
- *Climate.* In fact, the rainfall pattern has shown considerable decline during the last 3-4 decades with a highly significant annual decrease in the magnitude of 15 mm. Dry spells have become pronounced in the middle of the rainy season and there is a general decrease in the rainy season's duration from 5 to 3 months. The growing season has been reduced due to a prevailing lower

level of soil moisture in September and October. This has an adverse effect, not only on early maturing crops, but also on late maturing ones as well as the vegetative cover (grasses, shrubs and young regenerations).

- *Soil fertility.* Due to overgrazing (high density of animal population), over cultivation and erosion (deforestation & desertification), soil fertility in The Gambia is low. Except along the banks of the River Gambia where the soil is loamy, the soil is generally sandy with low clay and organic matter content and therefore low water holding capacity. The soil is poor in nutrients and of frail structure. Population growth has put pressure on the land of good quality. These factors all result in low productivity of crops. Farmers are however well aware of this situation and therefore use artificial fertiliser to enrich the soil, switch to mixed farming and employ crop rotation.
- *Access to farming inputs.* In general, the availability of farm inputs (fertilizer. pesticides and seeds) in sufficient quantities and the difficult access to credit, remunerating marketing channels and to adequate extension services hinders the efforts by farmers to increase their productivity.
- *Farming practice.* The level of mechanisation in the Gambia's agricultural activities is very low. Farming is mainly a manual job although the use of animal traction is widespread (see also table Table 5-2 for more details).

5.2 Renewable energy interventions for productive uses

5.2.1 Agricultural production and processing

<u>Irrigation</u>

Irrigation has been employed primarily in rice and vegetable production. The current rice irrigated area in The Gambia is around 2,300 ha and about 800-1,500 hectares may be put to horticultural crops. While irrigated rice is limited by natural factors such as intrusion of salt water and steep river banks, horticulture is constrained by lack of water pumps and distribution devices.

Investment costs in renewable energy pumping equipment (solar or wind-powered) are much higher than the alternatives (diesel, electric), but on a life-cycle basis, PV pumping can be economically more competitive, while other advantageous aspects are low maintenance and high reliability (if projects are well designed and organised). An advantage of PV water pumping systems as compared to other PV applications is that they generally do not need a battery for back-up, but can use a water tank for storage, reducing investment and maintenance costs and increasing system reliability.

Traditional irrigation techniques, such as total area flooding, typically involve low-frequency application of large amounts of water to reach excess saturation of soils. Not only is much of the water wasted, but this practice also contributes to the degradation of land through water-logging and soil salinisation, especially in arid

Table 5-3 Social and environmental impacts of renewable energy alternatives for productive uses

Sector	Social and environmental objective	Proposed renewable energy intervention
Agriculture and agro-processing	• Raising farm productivity and improve food security • Increased marketed household production • Increased income and finance • Conservation of natural and water resources	• Solar water pumping for horticulture and cash crops • Solar thermal ice plants for food and fish preservation • Solar drying for food conservation and fish drying • Solar or wind-diesel hybrid systems for water pumping, crop harvesting and food processing (analogous to the Mali Multi-Functional Platforms (MFPs)
Small and micro-enterprises (SMEs)	• Increased off-farm employment and income generation • Conducive environment for SMEs (SME advisory services, credit, skills and business development)	• Solar PV or small wind generators for cottage enterprises for income-generation beyond daylight hours and small tools • Solar or wind-diesel hybrid systems for small enterprises for welding, carpentry (analogous to the Mali Multi-Functional Platforms (MFPs) • Local energy service provision by small business (owned by local NGOs or cooperative), e.g. battery charging and solar PV service provision and maintenance

climates. However, new developments in water-conserving irrigation practices favour irrigation technologies, such as drip- and micro-irrigation that coincide well with the characteristics of PV pumping for small field sizes (up to 3 ha), characterised by low water use (using water-conserving irrigation methods) and low pumping head (up to 30 metres).

Given the lack of access to the power grid and the problems with maintenance of and supply of fuel for diesel pumps, there is a niche market for PV irrigation pumping systems in The Gambia, formed by small-holder plots of horticulture or cash crops, such as cotton. Even so, small-scale farmers have little capital available and this stresses the need for adequate financial support mechanisms (subsidy, credit) and adequate technical support (improved farming techniques, optimization of inputs such as fertilizer and ensuring better market access for the produce).

In The Gambia, the UNDESA-funded 'Managing Water Supply and Energy Services for Poverty Eradication' aims to expand water supply by appropriate energy systems to generate surpluses in vegetable gardens for income generation, to be followed by a second phase to provide energy for small entrepreneurs, ensuring community participation in project design and implementation by strengthening and involving community-based organisations (VDCs, water user committees and credit associations).

Since irrigation often takes part only part of the year, the demand for water is variable with peaks in a specific period. Solar (or wind pumping systems) have to be oversized to meet such peak demand, which makes them under-utilized for other months. Such water requirements for part of the year favour powered pumps that require a low initial investment, such as diesel pumps. This disadvantage of PV systems for seasonal irrigation could be cancelled out, by employing a high degree of system utilization through adoption of systematic crop rotation and developing alternative water uses, such as drinking water supply or livestock watering.

The availability of wind and solar resources greatly influences both the configuration and the cost of a renewable energy system. A good wind resource will favour the use of wind turbines, whereas a good solar resource will favour the use of PV. Another consideration is the variability of the resource, both daily and seasonally, which needs to be carefully matched with the need for water for irrigation, which will also vary seasonally. In addition, the longer the lulls in wind and sun resources, the larger the amount of storage needed.

Farm mechanization and crop processing

The powering of tools for off-farm activities with small renewable energy systems encounters obvious limits on the power supply side. Usually solar PV or small wind systems are not an option for energy-intensive activities such as in rice mills and other agricultural processing. This is similar to the case of refrigeration, small energy efficient units (up to 200-300 litres) can be powered with a small PV supply, but when the demand is for large refrigeration units the PV option often becomes too costly. The larger the electricity demand, the higher is the chance for diesel or gasoline-run generator sets. In any case, the larger the energy systems, whether diesel engines or renewable energy system, the less affordable by the average Gambian farming households

One promising initiative is formed by the so-called multi-functional platforms (see Box 5-1) that are built around a small diesel engine that can power various tools, such as a cereal husker, presses and an electric alternator which can drive water pumps, battery chargers and welding and carpentry equipment. In this segment of power supply, there is a growing interest is being devoted to hybrid power solutions, integrating PV and/or wind power with diesel generators to back up a battery bank. This option is worth exploring as an environmentally and economically sound supply of remote electricity in cases where the energy demand density is more concentrated and where the fuel supply is costly.

Usually, small-scale farmers produce the same crops, but in Gambia surplus produce from the majority of farmers can not easily reach the market due to transportation problems and is only seasonally satisfied.

Box 5-1 Mali Multi-Functional Platform

UNIDO-IFAD and UNDP-UNIDO implemented the 'multi-functional platform projects during 1994-1995 and 1999-2003. The multi-function platform (MFP) concept aims at enabling rural communities, and women in particular, to get out of the energy-poverty trap and have affordable and sustainable modern energy services.

The MFP itself consists of a source of mechanical and electrical energy, provided by a diesel engine of 8 to 12 hp connected to a generator and mounted on a chassis, to which a variety of end use equipment can be added, such as grinding mills, battery chargers, electric water pumps, vegetable oil presses, welding machines, carpentry tools and even mini-electricity grids for lighting. The configuration of equipment modules is flexible and can be adapted and/or expanded to the specific needs of each village.

The basic principles behind the programme are the following:

- *Demand-driven*. The project responds only to firm demand from communities in general, but formally from women's associations. The configuration of equipment installed is village-specific, depending on the specific demand (milling, de-hulling, water or power supply, allowing for flexibility in operating hours and seasonal needs.
- *Participatory feasibility* study, monitoring and evaluation. Before a platform is installed, a feasibility study is done for each demand, based on participatory tools. It is also an information-exchange stage where community members learn about the MFP concept, its opportunities, risks and costs, while the project staff collect data and estimate the feasibility of the installation, in cooperation with the rural communities.
- *Ownership and local skills*. Women of a village or a community wishing to buy an MFP are required to organise them-selves in a "formal" association. Local institutional capacity building is done from the end-use clients to the network of partners, such as the artisans, NGOs, etc. as well as the management committees and project staff. The multifunctional platform also stimulates the creation, development and/or modernisation of other artisan activities in the villages (e.g. blacksmiths, mechanics, carpentry, etc…).

The basic module of a platform, with an engine, rice de-huller, stone mill, battery charger and housing, has an estimated cost of US$ 4,000 (2001) in Mali. The project provided grants of up to $ 1,500 for the basic module, with the remaining 60% of the investment cost provided by village members, women's associations and credit organisations. Some 20 of the 150 MFPs were installed without subsidy from the project (2001 figures). Prices of the services are set to ensure the financial sustainability of the MFP and maximum affordability for local end-users, e.g. the milling and dehulling prices were set at the same level as the traditional mills.

In terms of livelihood, feasibility study have shown that the most desired outcomes were rest (saving women's burdensome and exhausting tasks (fetching, water or grinding cereals), income generation (from increased production and local processing of vegetable and cash crops as well as increased production by blacksmith and local artisans), supply of safe drinking water and increased education level (in terms of skills development of MFP operators and artisans as well as for girls and women making time available for training instead of drudgery household tasks).

In The Gambia, the Division of Energy has manifested interest in applying the MFP concept in the rural areas. To reduce dependence on diesel fuel, Mali aims to have 450 MFPs by the beginning of 2005, out of which 10% should run on biodiesel derived from *Jatropha* crops (see paragraph 6.3). Another way to reduce renewable energy is to employ solar/wind-diesel hybrid systems. There is therefore an urgent need for further analysis of the feasibility of application of *Jatropha* oil and renewable energy technologies for MFPs in the context of The Gambia.

Source: Brew-Hammond & Cole-Rees (2001)

One solution is to process the harvest by using the solar drying technologies for later selling (or for own provision in the 'hungry' season). Various low-cost solar types have been made for small farmers, such as cabinet or flat solar driers. Solar drying can preserve a variety of fruits, vegetables, grains, and some meat. Drying meat requires extreme caution since it is high in protein, which invites microbial growth. Fish drying, for example, requires thorough cleaning of the drier after each batch. More sophisticated solar driers have been constructed as well, such as solar driers with ventilation systems powered by electricity.

5.2.2 Small and mini-enterprises (SMEs); energy service businesses

The relevance of small renewable energy systems for productive uses is limited to the provision of power for off-farm activities that require little power input, e.g. in small retail shops, telecommunications shops (mobile phone and internet shops), repair workshops, handicrafts as well as small restaurants/bars (for light and radio/TV). One common example of productive use in rural businesses is related to the prolonged working hours due to lighting and as well as powering electric equipment, such as small drills or soldering irons.

Lights, radios, television sets, and cell phones may be operated using small PV systems (20-200 W) and wind-electric systems (300-500 W). Most of these loads can be operated using DC. For AC loads, such as those for colour TVs and VCRs, a small inverter can be included. Slightly larger PV systems (250-1,000 W) and wind electric systems (1,000-3,000 W) are suitable for slightly greater needs, such as light-use motors for sewing machines, refrigerators, hand power tools and fans, or for small amounts of heat (such as that needed for soldering irons).

Power tools, grain mills, or other large motors for workshops and light industries will typically need larger power systems. For larger loads (above 1 kWh/day), a big decision is whether or not to use a generator. Ultimately, this decision will depend on an analysis of the site in question. The principal advantage of generators is their ability to provide power on demand; their disadvantage high operating cost because of fuel and maintenance. Providing fuel and maintenance to the remote sites in The Gambia is often problematic. One solution is to combine the generator with PV modules, wind turbines, battery and/or inverter in hybrid systems that can meet larger loads. The renewable energy components minimize the generator run time, keeping generator operating costs to a minimum. The generator also precludes the need to oversize the renewable energy components, thus reducing capital costs.

One simple example of rural income generation, is the sale of electricity, generated by PV systems (e.g., renting out solar PV lanterns) or by diesel generator sets, possibly in hybrid configuration with solar or wind (e.g. to neighbours or in village-level mini-grids or battery charging stations). In Africa, Kenya is an example of a country where the sale of solar home systems to rural area has been commercialised, providing an additional source of rural income in the deployment and servicing by micro-enterprises of solar home and other renewable energy systems.

6 FOREST MANAGEMENT AND RE/AFFORESTATION

6.1 Forestry and wood fuel production in The Gambia

From an environmental point of view it is interesting to analyse wood fuel production sustainability and land use in The Gambia.

During the last three decades, only two detailed assessments of land use and land cover have been made in The Gambia, in 1982 and 1993. Assuming that a linear trend of land use change has occurred since 1993, the situation as of 2005 was assessed in the Lahmeyer forestry report (LI, 2005b)

The interesting trends here are:

- *Overexploitation and degradation of native forest resources*. This is well illustrated by the change of forest type areas detected by the last two forest inventories: in 11 years, 2,400 ha of woodland (a forest type holding on average 46 m^3 of wood/ha) and 32,800 ha of savanna woodland (with 33 m^3/ha) were lost, while tree/shrub savanna (a poorer forest type holding 20 m^3/ha) increased by 80,400 ha.
- *Agriculture with trees* increased by 1,200 ha, and 'agriculture without trees' by 14,800 ha, while fallow lands decreased by 49,600 ha. It is clear that these

Table 6-1 The Gambia, Land use 1982-1993-2005, in hectares

Land use/cover type	**1982**	**1993**	**2005**
Closed Woodland	14 400	12 000	9 382
Savanna Woodland	121 600	88 800	53 018
Tree/Shrub Savanna	280 400	360 800	448 509
Agriculture with trees	84 000	85 200	86 509
Agriculture without trees	226 400	241 200	257 345
Fallow land	138 800	89 200	35 091
Mangroves	68 000	59 600	50 436
Others	198 800	195 600	192 109
Total	**1 132 400**	**1 132 400**	**1 132 400**
Human-influenced cover	484 400	521 200	561 345

*Source: LI (2005b); 1982 and 1993 data, compiled from (*Ludwig and Bojang, 1998) and 2005 estimates by E. Riegelhaupt (LI, 2005b) changes in land use have been, and probably still are, an important source of wood fuels.

The impact of these changes in terms of forest stock and fuelwood production is mixed. On one side, the increase of cultivated areas implies a reduction of forest areas and wood production potential. On the other side, abandoned fallow areas are growing into young forest stands, thus increasing forest stocks and firewood production potential. The 1993 forest inventory found a slight decrease in total volume stocking for the country, with a substantial decrease in “woodlands” and “savanna woodlands” and important increase in “tree/shrub savanna”. Assuming this trend was continued in the following years, firewood stock might be approximately the same at 2005, since most of the area loss is concentrated in the forest types where timber species hold most of the volume.

In their present conditions, Gambian native forests are not capable to supply the current and future needs of energy of the country. Even in the best scenario of improved and extended management of native forests, the gap between demand and sustainable supply will continue to grow, either by depleting standing stock (in The Gambia) and or increasing imports (implying depleting wood stock in Senegal).

6.2 Sustainable forestry practices

In response to the increasing pressures on the forest resources over the past decades, the Forestry Department has responded in various ways for a sustainable use of forest resources.

Plantations

Plantations were the main occupation of the Forestry Department in the period 1950-1985. A total of about 13,000 ha were planted, mainly using monoculture *Gmelina aborea* and some *Tectona grandis* species. Government efforts to establish plantations were discontinued since the early eighties, as focus shifted towards biodiversity conservation and natural forest management, while *Gmelina* never caught on as a fuelwood substitution species (as at that time firewood prices were quite low).

In the nineties some private entrepreneurs have entered into the activity of *intensively managed plantations (IMPs).* Because of their high initial investment requirements, IMPs are not suitable for small farmers and its development should be undertaken by entrepreneurs with good managerial capabilities and access to credit[27].

27 An example of successful IMP can be found in Moukhtara Estates farm (near Pirang, in Western Division). This *Gmelina arborea* plantation was established in 1992-1994, by interplanting seedlings in horticulture land. It received supplementary irrigation in the first three years and has been thinned since the fourth year. Standing stock at year 2005 (age 12 years) is 244 m^3/ha or 152 tonnes per hectare, with an estimated mean annual increment (MAI) of 30.5 m^3/ha/a or 19.1 m^3/ha/a (assuming 50% of growth was removed by thinning)

These types of plantations, using state-of-the-art technology, are high-input and high-yield sources of energy and construction materials. They are usually established in medium or big plots, sometimes using genetically improved materials[28] as well as careful planning and supplementary irrigation in the first two or three years. IMPs are characterized by very high productivity (8 to 40 tonnes per hectare per year), very short cycles (4 years), early production (starting from year two) and potential high levels of profitability (internal rate of return from 34% to 175%). Apart from fuelwood, these type of plantations can be combined with food crops only in the first year, but have also the capacity to produce substantial fodder amounts (in the case of *Leucaena*, 6 to 12 tons of dried leaves per hectare) and sawable timber (LI, 2005b).

The critical issues that have to be cleared in order to develop an IMP program are land and water availability, land tenure, and investment capital. Even a modest program, of some 10,000 ha in 10 years, will need about US$ 400,000 per year for the first four or five years, before becoming auto-sufficient. On the other hand, such a program could sustainably produce 300,000 tonnes per year, thus potentially making a substantial contribution to national wood supply.

Village forestry and woodlots

Multi-purpose woodlots (MPW) can be established and managed by farmers in the vicinity of roads or consumption centers, as a mean for income improvement and diversification. Degraded land can be used whenever the water-table level is not deeper than six meters. *Eucalyptus camaldulensis* and *Gmelina arborea* grow well in these lowland soils, but also *Leucaena leucocephalla* can be used if forage production and/or soil fertility enhancing are sought. All three species have nectar-bearing flowers and are good for bee-keeping.

The LI (2005b) report provides some figures on costs and returns for Eucalyptus woodlot (see Table 6-2). The mean annual increment (MAI) in this case is 5.6 tonnes of wood per hectare per year, of which up to 50% of this can be used as construction materials (fence and/or building posts). In this type of woodlot, crops can be interplanted in the two first years of each cycle, and will be benefited from the supplementary irrigation. The potential of multi purpose woodlots as a source of energy depends on the extent of available land. Assuming one tenth of arable lands could be used for MPW, 30 000 ha might produce about 170 000 tons of fuel wood per year.

Some efforts have been undertaken to involve small farmers in reforestation, notably in programmes supported by USAID and the European Community. Despite the potential benefits, these projects have not proven successful for a number of reasons, such as customary law and land tenure rights (that may not allow tree planting for profit by individual farmers), difficulty and sharing profits on

[28] New plantation technology, combining genetically improved materials (clones from hybrid *Eucalyptus* of very high growth potential and drought tolerance) with intensive management is now available. This technology has been developed in Northeastern Brazil, a region with climatic and soil conditions very similar to those prevailing in The Gambia.

Table 6-2 Cash flow and yield of Eucalyptus woodlot

Year	Direct costs D/ha	Returns D/ha	Balance D/ha
1	25388		-25388
2	1600		-1600
3	500		-500
4	500		-500
5	2823	42344	39521
6	1600		-1600
7	820		-820
8	500		-500
9	500		-500
10	1634	24504	22871
TOTAL	**35864**	**66848**	**30984**
Production at year 5	35,3 t/ha	IRR	15%
Production at year 10,	20,4 t/ha	Benefit/Cost	1,86

Source: Lahmeyer Int., 2005 (values in 2005 Dalasi)

communal woodlots and orchards, the reluctance in accepting exotic species (such as *Gmelina* and *Eucalyptus*) by the local farmers as well as the top-down approach that was generally followed in establishing these woodlot projects.

Participatory forest management

In the framework of technical cooperation between Germany and The Gambia, the Gambia-German Forestry Project (GGFP) developed a community forestry programme in 1989-91, which has become a blueprint for sustainable forest management in The Gambia since the mid-nineties. Public participation in forest management was endorsed by the Forestry Act of 1998. The Local Government Act of 2001 has provided another opportunity for community-involvement in forest management.

Several strategies have been implemented to promote participatory forest management:

- Participatory *community forestry management* (PCFM agreement, in which a village or community can be involved in the management of non-park forest areas upon agreement with the Forestry Department). Some 14,600 hectares were under PCFM in 2004[29].

[29] In PCFM agreements, traditional wood uses are not affected (firewood, fruits, plants for medicinal and fodder use can be freely gathered), certain products can be collected in accordance with the management committee (*sibo* leaves and grass for roofing), while timber and firewood for sale can only be harvested according to a management plan and on a communal basis.

- *Joint forest park management* (JFPM, aiming at actively involving peripheral communities in the protection and sustainable utilization of forest resources[30]. Throughout Gambia, some 18,000 ha were under JFPM in 2004.
- *Community-controlled state forest* (CFM, in which communities, that have proven to be satisfactorily participating in community forestry, are invited to participate with the Forest Department in the management of 'open access forests'. Some 5,600 ha were under CFM in2004.

Towards the end of the GGFP, GTZ commissioned a study to evaluate the impacts of community forestry:

- Awareness and knowledge of environmental issues (land degradation and sustainable forest resource management) had been raised remarkably, while the occurrence of bushfires has reportedly been decreasing;
- According to recent FAO statistics, the decline in forest land area has been stopped and actually increased with 1% (from 42 to 43%), of which part can be attributed to the community forestry programme;
- Branched firewood collection has become an important commercial product of villagers, alongside fruit and nuts, while the collection of deadwood has reduced bushfires. On the longer term, the decreasing bushfires should have a positive impact on grass and fodder availability for cattle
- Although no deliberate assessment was made in the study on impacts, the income-generation (sale of firewood and fruits) will have an income-generating impacts as well as having a positive gender dimension (since usually women are involved traditionally in selling firewood, fruits and herbs).

6.3 Energy crops

Through mechanical processing, an oily substance can be derived from certain plants, such as *Jatropha* (physical nut) or oil palms. The seeds of the *Jatropha* contain 32-35 % of oil. With mechanic oil expellers up to 75-80 % of the oil can be extracted. One interesting application is making soap, which can be done at village level, where the entire value added then benefits the village community (Henning, 2000).

At the industrial level, further chemical processing (transesterification and esterification) gives a fuel, which can be used a substitute for diesel in engines, called biodiesel. Apart form the environmental benefits of reducing CO_2 emission through substitution of diesel and carbon sequestration in the crop plantations, other benefits would be the savings on Gambia's import-export balance (by saving on fossil fuel imports) as well as provision of work opportunities in rural areas.

30 Acknowledging the lack of capacity of the Forestry Department to put a proper management system of the parks, which over the past decades had ed to alarming rates of encroachment and forest degradation

7 PARTICIPATORY AND DEMAND-ORIENTED PROJECT CYCLE MANAGEMENT

7.1 The rational for a demand-oriented approach in energy planning

Traditionally, the rural energy sector has been dominated by a supply-driven paradigm. Past projects, often supported by multilateral and bilateral funding agencies have typically focused on technology, e.g. the extension of the electric grid or supply of solar photovoltaic (PV) for basic household energy needs. The majority of such projects were conceived without in top-down decision-making by government officials without much involvement of the other stakeholders from the private sector and non-governmental sectors. Many of these projects still neglect to take into consideration from the onset the specific needs and preferences of different end-user groups, supposedly the beneficiaries. Often, the focus in the planning and project cycle is on project design and implementation, while the monitoring and evaluation remains an ex-post data collection exercise, measuring strictly quantifiable indicators, such as the number of renewable energy systems installed. Also in The Gambia, various renewable energy projects have failed owing to lack of priority given to local involvement, training and ownership and inappropriate institutional set-up and enabling environment to support long-term sustainability of projects.

More recently, rural energy planners recognise that:

- Technology cannot be introduced in isolation of the level of development in society. Unfortunately, there are numerous well-intentioned projects that in the end have had little impact, because they only addressed one a few of the *barriers to market development* of the technology. For example, many improved wood stoves projects have failed, because they focussed on the technical design details, but were not accepted or preferred by households. New rural energy technologies are often abandoned by the end-users after the project's end, as the funds for operation and maintenance dry up or there are no organisations available that cannot provide such after-sales service. A renewable energy master plan should not only make a match between the various renewable energy technologies available and the demand by rural and urban people for social or productive uses, but should built on components that address the barriers to the widespread introduction of renewable energy technologies by:
  - Building a conducive policy and regulatory framework for energy that integrates (rural) development with energy objectives together with institutional strengthening
  - Promoting the development of a business and technology support system and appropriate delivery mechanisms
  - Raising finance availability through innovative finance mechanisms, involving private sector, micro-credit organisations and end-users'

contributions, supported, but not driven, by government subsidy and donor grants
  - Engaging the various stakeholders (government official from energy and non-energy department, private and financial sector, micro-credit organisations, NGOs and, last but not least, local communities and the end-users) by means of information and awareness creation, capacity and knowledge strengthening and by adopting a participatory approach in the design, implementation and monitoring and evaluation of renewable energy projects.
- The *uses of energy, social and productive,* reflecting the needs and preferences of the beneficiaries (including the poor and women), need to be central, rather than having a focus on a particular energy technology. This implies also a focus not only on electricity, but recognising the importance of heat applications, as the majority of households needs heat for cooking and are dependent on biomass. Loss of technology focus implies also that one technology should not exclude the other. For example, in some cases a solar PV or wind turbine charger will be a good option, in other cases renewable energy may not be a feasible option at all in comparison with small diesel generators, while in other cases a solar/wind diesel hybrid can be considered. The firewood scarcity problem cannot only be addressed by the introduction of improved wood stoves, but consideration should be given to alternative fossil fuels, such as LPG, although this might run against the environmental objectives of many donor-driven programmes.

7.2 Removing barriers to development of renewable energy technologies

7.2.1 Development of a policy framework for renewable energy

Integrating energy with poverty and rural development

It has often been observed that planning and implementation of rural development and energy development projects are carried out independently. Consequently, rural energy projects are perceived as stand-alone development projects. For example, income-generating activities with energy services as input can ensure the local communities' long-term affordability of energy services, while these services themselves are often necessary to raise productivity of agriculture and non-farm productive activities.

From an institutional point of view, the 'energy and development' sector in The Gambia is fragmented over various agencies and organisations, involved in energy, forestry, community development, agriculture, rural infrastructure, micro-finance and enterprise development. The current National Energy Policy of The Gambia takes the usual supply-side oriented approach, hardly covering the issue of the linkages with poverty alleviation and rural development. It is recommended that the Renewable Energy Master Plan, current under development, should cover both supply and demand issues.

Institutional strengthening

If one considers that energisation is conducive for rural development, one should actively promote programmes and projects that integrate rural and energy development. This requires the strengthening horizontal linkages among energy, rural development and other relevant government agencies as well as with non-government stakeholders involved in the planning and implementation process. This suggests the establishment of some form of “Energy and Development Committee” of the various governmental and non-governmental organisations in which various partners (government, private sector, NGOs, as listed in paragraph 3.3, and development agencies) collaborate in a systematic way with the aim of addressing environmental issues (such as fuelwood scarcity), social issues (affordable energy services for the poor) and gender issues (improving access of women to energy services) in a systematic way both at national as well as district level.

Such and “Energy and Development Committee’, chaired by the President Office’s Energy Division, might take the lead in developing energy and development plans at national or district level, taking a holistic approach, by looking at homogenous areas based on agro-ecological condition, socio-economic and/or energy situation. Some peri-urban areas may be good candidates for connection to the utility grid because of their level of socio-economic development and proximity to the grid, while most rural areas will have potential for certain renewable energy sources. Such area-based energy planning should be based on and/or incorporate area-based energy needs assessments, rural development plans (small enterprises, education, health, etc) and biomass production (forestry, agriculture) programmes as well as on seeking synergies with donor-funded projects in the area of community development and agriculture[31].

The existing Gambian Renewable Energy Centre (GREC), under the Division of Energy, has lacked capacity and has not been very active of late. Its capacity should be strengthened to play a visible role as the technical arm of the Division of Energy in promoting research and development on adapting renewable energy technologies (improved stoves, solar driers, wind-mechanical pumps, etc.) to local conditions, assessing energy and technology needs in rural areas, acts as an information centre and encourage pilot initiatives by NGOs and local organisations.

[31] For example, the AfDB is funding or planning to fund projects on community skills development, integrated watershed management and farmer-managed rice irrigation, while the World Bank is funding or planning to fund projects on community development and municipal capacity building, while UNDP has projects on improved rural water supply and capacity building for young people on environmental issues.

7.2.2 Development of business, technology support and financing systems

Private-sector entities participate in renewable energy projects as manufacturers, dealers, consultants, local project developers, financial intermediaries, recipients of technical assistance, technology suppliers and contractors, and project executors. In addition, international and national NGOs, community-based organizations, farmers or women's associations can be involved in the design and implementation of renewable energy projects.

A small number of private companies are involved in renewable energy systems in The Gambia, mostly solar home systems and water pumping. One company in Brikama is involved in wind technology. Improved wood stoves are made and sold to local markets by artisans.

Barriers were encountered by private firms and NGOs involved in renewable energy technologies. Renewable energy hardware is not readily available in The Gambia and is usually imported on a project-by-project basis. In donor projects import duties may be waived, otherwise they add to the barriers formed by high initial investment cost. Businesses wishing to market renewable technologies may lack the capacity to develop business plans and obtain commercial financing. Because of the low volume of existing markets, renewable energy importers and businesses face high per-unit costs and may be unwilling to provide service and maintenance, without financial backing. A more detailed assessment is needed of the barriers that businesses and NGOs face, regarding renewable energy technology applications in The Gambia. Such an assessment should review possibilities for local manufacturing (e.g., wind mechanical pumping systems), development of managerial and technical skills, quality assurance, operation and maintenance, market development and promotion as well as finance mechanisms.

Credit can improve affordability but there may be a lack of credit access and credit delivery mechanisms. Commercial banks usually do not perceive rural households as credit-worthy, due to the lack of practical collateral or legal issues regarding enforcement of contract, while the small size of loans involved is not enough to attract their interest. New financing services are an important aspect of renewable energy projects to get away from the lopsided dependence on donor grants. In many solar home systems projects in the world, new credit mechanisms are developed that can make systems more affordable to consumers. In some projects, private dealers obtain commercial financing and then extend credit to their customers; in others, existing micro-credit organizations offer financing, while still others organise rural energy service companies operating on a fee-for-service basis with low monthly payments so that poor customers can afford the technology.

In all cases, the financial viability of the renewable energy technology increases if the rural energy service is integrated with rural business. Productive uses of energy that will enjoy extra revenue as the result of the renewable energy technology's application will generate income, thus increasing the capacity of end-users to repay loans for the energy (and non-energy) technology employed in the activities.

There is no universal ‘best financing’ model (cash for sale, fee for service, credit, leasing, rent, grant, etc.), because different consumers require different models (paying capacity; social/productive uses) and different renewable energy technologies require different models, based on the level of application (individual household, small enterprise or village). However, one would always try to look at an optimisation of funding with donor funding as seed money (for the opportunity and feasibility analysis, capacity development activities, guarantee facility and only a small part of equity) combined with commercial financing by an intermediary institution (bank or rural energy fund) through local micro-credit and community institutions) for the other part of the investment, with users charges to cover operations and maintenance (or even re-investment after the technology’s useful life).

7.2.3 Participation by stakeholders

Participation is a process through which stakeholders influence and share control over development initiatives and the resources and decisions that affect them. In traditional project design and monitoring, the role of stakeholders is often limited to a one-way flow of *information* (from decision-makers to the stakeholders, information dissemination, or from stakeholders to decision-makers, information gathering) and, at best, *consultation* (two-way flow of information). In a more modern approach, the stakeholders’ role is participation, i.e., *collaboration* (shared control over decision making) or even *empowerment* (transfer of control over decisions and resources).

With respect to the formulation of the Renewable Energy Master Plan, a number of stakeholders are listed in paragraph 3.3, while a more detailed ‘institutional analysis’ as part of Lahmeyer’s Renewable Energy Study, should give more insight the stakeholders and their capacity to be involved in renewable energy issues and options. Table 7-1 provides an indication of possible involvement of certain stakeholders in the formulation of the Master Plan and subsequent definition of specific projects.

Table 7-1 Possible level of involvement of stakeholders

Stakeholder	Energy policy	Renewable energy plan	Renewable energy projects	Monitoring, evaluation and adjustment
Government & agencies	A	A	A	A
Private sector (energy technology and services)	C	B	A	A/B
Financial institutions	C	B	B	B
NGOs	B	B	B	B
End-users and groups	C	C	A	A/B

A: high involvement (empowerment, collaboration), B: consultation, C: information

Possible strategies for stakeholder involvement, include participatory assessment of current energy and development projects at national as well as local level and organising pilot activities involving a range of stakeholders (at the same providing on-the-job training opportunities).

With respect to the formulation of the Renewable Energy Master Plan, a workshop is planned to discuss the results of drafting Master Plan. It is suggested that a broad range of stakeholders from governments, NGOs, private sector, donors and grass-roots organisations are invited, so that their view are incorporated during the design of the Master Plan.

7.3 Participatory design, monitoring and evaluation of renewable energy projects

Based on the results and achievements of the draft Master Plan, specific *renewable energy projects* will be identified and prioritised. Each project may be specific to a certain supply option or demand activity, or it may be a project comprised of a number of technologies relevant to the concerned village or cluster of villages. Actors at this level are governmental implementing agencies, NGOs, private sector firms, and the community itself.

Past renewable energy projects in The Gambia (supported by multilateral and bilateral funding agencies) have typically focused or supply of specific renewable energy device. The majority of such projects were conceived without sufficient recognition of the needs and preferences of the consumers or end users. Projects that start with the assumption that a particular application is the only solution cannot possibly respond to the many pressing needs faced by rural populations. A key activity in the project preparation and design is the identification of the community's specific energy needs for water pumping, agricultural processing, work productivity, health, education and security, followed by translating these energy needs in the planned projects.

Under a conventional approach to the monitoring and evaluation of outputs and impacts, no activity takes place until the project reaches the implementation phase. Once implementation has begun, important changes that impact the objectives of the project are monitored, and at the end of the project, it is evaluated based on whether or not it achieved its targets. A new approach, advocated by this report, begins the monitoring and evaluation process already at the preparation stage of the project, so that the input of the potential beneficiaries helps shaping the design of the project. It is suggested that for rural energy projects, *participatory assessments* are combined with *socio-economic and environmental impact surveys*, implemented during the later stages of the project. The results of the participatory approach can be used not only to inform the project's design, but also in designing and pilot testing the socio-economic impact survey. Participatory assessments not only provide data for policy makers project designers, but also build local capacity through community participation in planning and subsequent managing of the project.

The participatory assessment evaluates aspects like mobilizing community participation, local training requirements, local funding capacity and willingness to pay, poverty and gender. Types of activities involved, include stakeholder meetings, group discussions and other participatory techniques. Such assessments are typically conducted during the preparation phase of the projects, but can be repeated during monitoring and evaluation to identify problems. Socioeconomic impact surveys can be conducted at periodic intervals during the project's implementation as well as after the project's end. Such surveys can provide important information on actual energy demand and supply, markets for new energy services, acceptance and attitudes of people towards new technologies as well as benefits (e.g., productivity, education, health, convenience) and environmental impacts (e.g., and use, natural resources).

Effective participation of communities can take place only when the capability and willingness to participate exists. While participation can occur in many ways, an important requirement is that communities make concrete resource commitments as part of their participation. Most successful rural projects are associated with community commitment in terms of investment or other substantial in-kind contributions. It is important to recognize also that rural communities are not homogenous groups. Different groups could have different interests, sometimes of opposing positions, with regard to an intended project for their area. Conflicting interests could stem from differences in socio-economic status, access to land and other natural resources, cultural background, gender perspective, and political power.

7.4 Indicators for planning and project development

The above-sketched demand-oriented and participatory approach to project design, monitoring and evaluation is dependent on obtaining information for a key set of variables. The purpose of indicators is to highlight social and development issues as well as environmental aspects. A generic key set of such indicators is given in Table 7-2 and can be used for the Renewable Energy Master Plan as well as subsequent projects.

Of course, the final choice of variables and indicators will depend on the scope, objectives, activities and local context of the specific priority projects chosen as well as on choice of technology and energy service delivery mechanisms. In some case, only a subset of the indicators will be used, while in other projects this list of indicators needs to be supplemented with other ones. Some indicators can be gathered from secondary sources of information or measured easily. Other indicators will need surveys and other methods, in which a balance must be found between budget availability and information needs.

Table 7-2 Key indicators for project design, monitoring and evaluation

Renewable energy technology (RETs) and systems (grid-connected, off-grid electricity, heat and mechanical power applications)	• Number of systems installed and/or capacity of systems installed (in kW or delivery of MJ) • Annual energy production (kWh or MJ) • Affordability of fuels (prices of diesel, gasoline, kerosene, fuelwood and charcoal) • Electricity prices (grid, mini-grid and individual systems) • Investment cost and life-cycle production (cost per unit of energy, kWh or MJ; including equipment cost, installation cost, overhead cost and O&M cost • Financial viability (economic and financial feasibility of energy technologies in terms of NPV and IRR; presence and nature of subsidies; repayments rates)
Access and use of RETs	• Access to energy services (number and % of households or end-users that receive energy services; choice in services, appliances and equipment offered) • Effective functioning (quality of service operation, load or energy demand being met; reliability and predictability of service) • Energy demand and service (end user awareness on RET use and capabilities; awareness of social benefits and productive uses of RETs)
Degree of change in socio-economic development	• Number of villages receiving energy from RETs (clinic, school, telecommunications, village centres) • Education (ability to attend school, quality of education and presence of teachers, time spent on education) • Health care (access and quality of health care, access to medicines; decline in diseases; presence of health workers) • Convenience, comfort and domestic productivity (ability to conduct, time spent and efficiency of non-income generating activities; leisure time; time spent on watching radio/TV) • Access to information and communication (access to news and information on income-generating activities; on health, safety and family planning; communication with distant family members) • Water supply (number and distribution of wells powered by RETs) • Ability to do income-generating activities (number and % of small and micro-enterprises using RETs; number of SMEs operating because of access to new energy services; applications in agriculture, e.g. irrigated area, kg of crop milled or de-husked) • Productivity/efficiency and profitability of income-generating activities (value added generated by productive uses of energy (number of farming households and income generated; number of families out of extreme poverty; value generated in SMEs)
Participation in service establishment and operation	• Effective management (fee-tariff system, capacity to troubleshoot problems, repair and spare parts timeliness and availability; budgeting and accounting system; end-use training; level of skills created through training of energy device manufacturers; capacity of relevant local authority or energy committee; coordination between end-user(s) and service provider) • Division of costs of benefits of RETs between and within households; division in decision-making
Financing systems	• Availability of consumer (micro) credit for purchase of off-grid RETs, including dealer-supplied credit, microfinance, and credit from development banks (awareness among financial institutions

	number and % of financial institutions and micro-credit organisation involved in energy-relevant lending; volume of lending for off-grid RETs (and PUE) (agreements, commitments); characteristics of financing programs dedicated to renewable energy technologies • Profitability of lending for RETs (repayment rates by end-users and financial returns; guarantee schemes for RET lending) • Amounts of government, commercial, and bilateral/multilateral financing for grid-connected RET facilities
Involvement of private sector and NGOs	• Awareness and experience among project developers (capacity building programme; staff trained; number of energy-relevant workshops; number of RET system manufacturers/importers, dealers, installers/service firms) • Awareness and ability of NGOs to incorporate energy services (RETs) in their activities (number of activities, staff dedicated) • Improved dialogue between government, private sector and NGOs (RET seminars and workshops, etc.) • Existence and appropriateness (to local needs) of equipment quality standards and certification procedures for equipment and installation • Cooperation mechanisms and dependence on donor funding
Policy support for RET development	• Awareness among government officials and NAWEC and changes in organizational structures (bureaucratic vs. networking; national and local) in RET promotion • Number and type of RET projects being developed • Existence of policies and plans regarding RETs and rural energy (existence of working regulatory/social models for rural energy services (village power) schemes (including ownership and equity, tariffs and responsibilities for O&M); characteristics of electric power regulation and policies for independent power producers, power purchase agreements, transmission wheeling of generated power, and power dispatch requirements; clear and fair rules for IPPs; fairness/equivalence of wholesale tariff structures for generation from renewable energy sources relative to those for conventional fuels) • Knowledge base for technology application (e.g. wind and solar resource maps, RET operations and maintenance experience, RET information dissemination) • Government priorities regarding RETs (fund allocation in the energy sector; capacity (number of staff, budget for RET development; staff trained; capacity building programs); official government statements on RETs)
Environmental impacts	• Impact on global climate (greenhouse gas emission reduction or limitation; share of renewable energy relative to conventional and other fuels) • Impact on woodfuels consumption and forest resources • Level of local pollution (air, soils, water) • Impact on physical environment (land use patterns, surface water and ground water level and quality; soil quality and erosion) • Impact on biological environment (e.g., deforestation and vegetation cover; biodiversity, ecosystems and wildlife) • Local natural resource management (e.g., local committees established and functioning on management of water and forest resources; level of involvement of people in such committees) • Improved management practices in agriculture, forestry and animal husbandry

8 ANNEX A REFERENCES

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9 ANNEX B LIST OF NGOs

TANGO MEMBERSHIP LIST

	ORGANISATION	CONTRACT PERSON	STATUS	TELEPHONE	FAX
1	Action Aid The Gambia	Yahya M. Sanyang	Internl.	4392244/2004	392425
2	ADWAC	Mam Samba Joof	National	7720106	720112
3	Anglican Mission Development Minitries	Rt. Rev. S. Tilewa Johnson	National	4227405/5966	229495
4	Association of Farmers Educators, & Trade	Malafi Gassama	National	4484611/993606	484100
5	Association of Gambia Entrepreneurs	Amira Jagne	National	4393494	
6	Association of Promoting Girls & Women Advance	Binta Sidibeh	National	4392862	392826
7	Boka Loho Society	M. Lamin Jagne	National	4390969/9913631	371630
8	Catholic Relief Service The Gambia	Carla Brown Ndiaye	Internl.	4227120/21	
9	CHIGAMBAS	Haddy Njie	National	5668042	494474
10	Christian Children's Fund	Gustace Cassell	Internl.	4392693/1450	224652
11	Community Action Development Association	Oustass Gaye	National	4390682/756	370624
12	Concern Universal	Niall O'Connor	Internl.	4494473/75	
13	Fang Dema Kafo	Ebrima Bah	National	5668657	668004
14	FAWEGAM	Ramatoulie Secka	National	4495037	
15	FORUT - The Gambia	Musa Jeng	National	4495622	396892
16	Freedom from Hunger Campiagn	Landing Jaiteh	National	4497082	496316
17	Future in Our hands	Hjori Henrik	Internl.	4460363/360	460357
18	Gambia Artisanal Fisheries Development Assoc.	Ousman Bojang	National	4495584	
19	Gambia Association for Physical Disable	Alhagi Touray	National	4224425	
20	Gambia Association for the Hard of Hearing	Momodou Sanyang	National	4201166	
21	Gambia Family Planning association	Yankuba Dibba	National	4391473/1945	392463
22	Gambia Food & Nutrition Association	Albex Cox	National	4390433/434	390435
23	Gambia Girls' Guide Association	Ramatoulie Secka	National	4390510	
24	Gambia Home Economics Association	Sarah Secka	National	4394429	
25	Gambia Midwives Association (GMA)	Francis Foord	National	4497416	
26	Gambia Organisation of the Visual Impaired	Momudo Touray	National	4227001	
27	Gambia Red Cross Society		National	4392405/3179	394921
28	Gambia Women's Finance Association	Ms. Kati Jatta	National	4397063/4	392062
29	GAMCOTRAP	Mary Small	National	4497416	487781
30	GARDA	Kebba Bah	National	4461711	
31	Hope For Children	Mr Arfang kanuteh	National	9911792	
32	Human Development Society - HDS	Musa Sinera	National	4392951/9919375	
33	International Organisation of Good Templars	Ousman Baldeh	National	4496042	496042
34	International Society for Human Rights	Sheikh E. T. Lewis	National	4395039	392866
35	Ismalic & Relief Association	Phoday Kebba	National	4370418	370953
36	Juffuerh & Albreda Youth Society	Mamadi Faal	National	4224914	224914
37	Lend A Hand Society	Francis Mendy	National	4390550	
38	Medical Research Council		Internl.	4495442/3/4	496513
39	Methodist Mission Agricultural Programme	Sonnie George	National	4484853	484327
40	Micro finance Promotion centre - MFPC	Sariang Jobarteh	National		
41	National Women's Farmers association (NAFWA)	Kujejatou Manneh-Jallow	National	4202503/4	202501
42	Njawara Agriculture Training Centre	Badara B. Jobe	National	5720121/143	
43	Njawara Cultural Camp	Lamin Jeng	National	5720121/130	
44	Noble Pursuit Organisation	Sulayman A. Bah	National	4395854	393274
45	People In Action	Momodou Jobarteh	National	4390776	
46	RAID	Sambujang Conteh	National	7720103/162	720112
47	Self Reliant Development Association (SERDA)	Gallah Sissay	National	7781443/7701572	
48	Sheikh Mass kah Islamic Foundation	Baboucarr Kah	National	4374927	
49	Sight Savers International	Dr. Jerreh Sanyang	Internl.	4497049/6203	
50	Simma vocational Training Centre	Ousainou Jobarteh	National	4372830	372830
51	SoS Childrens Village	Dembo Bojang	Internl.	4461914	461924
52	Stay Green Foundation	Baboucarr Mbye	National	9946991/710293	390435
53	TANGO(The Assoc.of Non-Governmental Org.)	Ousman Yabo		4390521/525	4390521
54	Trust Agency for Rural Development (TARUD)	Sandang Bojang	National	4486313	486026
55	Village Aids - The Gambia	Dawda Kebbeh	Internl.	5748045	
56	Voluntary Services Overseas	David Clamp	Internl.	4495409	496946
57	Women Advancement And Chil Care - WACC	Lamin Saidybah	National	4485227/9996537	
58	Women In Services, Development Organisation	Mariatou Loum	National	4390536	225385
59	Worldview International Foundation	Adeliade Sosseh	National	4496990	496666

10 ANNEX C LIST OF MEETINGS

During the mission of the Social & Environmental Expert, Mr. Jan van den Akker, 10-27 July 2005, the following meetings were organised:

12 July - *Office of the President* (Mr. Bah Saho, Director of Energy, tel. 420 0050, 991 9585, bahsaho@yahoo.com, energy@qanet.gm)

14 July - Participation in the "*Workshop on the Criteria for the Renewable Energy Study*" (at Kombo Beach Hotel), organised by Lahmeyer and the Division of Energy

20 July - *Gambia Tourism Authority* (Mr. Amadou Ceesay, Director Human Resources, tel. 446 2491, 996 3300, amadou_ceesay@hotmail.com)

23 July - *GAM Solar* (Mr. Omar Touray, tel. 446 0189, 992 1935 gam.solar@usa.net, info@gamsolar.gm; Mr. Hans Nooteboom)

25 July - *Department of State for Finance and Economic Affairs* (Mr. Paul Conteh, tel. 422 6766, 778 7928, dosfea5@gamtel.gm)

Department of Forestry (Mr. Jato Sillah, tel. 422 7307, 778 4940, forestry.dept@gamtel.gm; Mr.

Department of Fisheries (Mr. A. Mendy)

Department of Community Development (Mr. Aussainou Jabarteh, tel. 422 8178, 993 1611, dcdbjl@qanet.gm)

Department of Lands (Mr. Jatta, tel. 422 7337, 996 0753)

TANGO - The Association of NGOs (Mr. Yabo, Director's office, tel. 439 0821

26 July - *Department of Water Resources* (Mr. Jaju)

United Nations Development Programme (Mr. Omar Njie, tel. 449 4771, 449 4760, omar.njie@undp.org)

27 July - *Department of Community Development, Research Centre, Brikama* (Mr. Suware, tel. 992 2864)