PROJECT PROPOSAL

ON

INTEGRATED ENERGY SUPPLY FOR BAOBAB SECONDARY SCHOOL

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- Biogas plants
- Vegetation plot
- Solar water heating

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1 SUMMARY

The Project Provides an alternative solution to the fuel wood problems in Baobab Secondary School, and the scheme is of immense potential to conserve and protect the environment when applied on a wider scale. Baobab Secondary School alone requires 650m^3 of firewood that costs Tshs. 26 million per year; there are more 3300 Secondary Schools in the entire country require 2,145,000m^3, which is an alarming rate of deforestation.

Given that, School sewage can generate up to 70% of cooking energy in the Tropics – by use of anaerobic technology, 100% fuel sufficiency will be achieved in Baobab Secondary School by topping biogas plants with cow dung, plant foliage, and use of solar hot water in the kitchen (to use water at 80 °C, instead of beginning at 25°C).

The Project main outputs: (i) entire replacement of firewood in the kitchen with superior and sustainable energy, and thus saving 65m^3 of firewood per month, and 650m^3 (Tshs. 26,000,000) per year, (ii) the project to serve demonstration, research, and teaching purposes, (iii) annually avail 360 tons of conditioned organic manure sufficient to fertilize 15 Ha of cropland for each planting season.

Budget summary

S/n	Item	Qty	Sub total, Tshs
1)	Biogas plants	75m^3 x 3	45,374,500
2)	Sewage drains	180m	4,830,000
3)	Solar hot water:	20m^2 x 1,000l	12,400,000
4)	Foliage plot	0.5 Ha	6,750,000
	Total		**69,354,500**
	Exchange Rate USD to Tshs 1,250		**55,484**

2 SCHOOL PROFILE

2.1 Ownership

Shajar Schools Association (SSA) was registered on 18th May 2004, certificate of incorporation number 48933 as a company limited by guarantee and a non-profit organization with the main objectives including:

To establish and run schools, colleges and other educational institutions and to act as a holding organization in the provision of education at various levels of nursery, primary, secondary and university; and in fulfillment of the above objectives SSA registered an exclusive boarding girls' secondary at Mapinga Village, Bagamoyo District in the name of Baobab Secondary School and was given certificate of registration number S 1597 by the Ministry of Education and Culture.

2.2 The Project Area and Context of the District

Baobab Secondary School is located in Bagamoyo District, Coast Region at latitudes 6° and 8° South of the Equator and between 37° 30' and 40° East of the Greenwich meridian line and at an altitude 100 meters above sea level. It is located approximately 40 kilometres from Dar and 30 kilometres from Bagamoyo.

One of the most notable features of the education system in the District is that, male genders are placed in a more favourable position than female gender. The reasons have been early marriages for the sake of a dowry, prevalence of unwanted pregnancies, the need of girls to help domestic chores and parental passive/suspicious effects of education will impart to their daughters. In the District, there are strong social pressures that deter families from sending their female children to secondary schools, since the tendency is to be suspicious that they could be contaminated with secular morals. Considering that equal rights between men and women are guaranteed by the country constitution and that since Tanzania is a signatory to the Convention of the Elimination of All Forms of Discrimination against Women (CEDAW), this is indeed a serious anomaly which parties must strive to eliminate as the education has positive interrelationship to the promotion of maternal and child health and family welfare in general, the economic, social and political benefits.

This is the historical background that SHAJAR SCHOOLS ASSOCIATION established an exclusive girls boarding junior (O level) and senior (A level) secondary school at Mapinga village Bagamoyo District, Coast Region).

2.3 The School

Baobab Secondary School is a campus style girls boarding establishment opened to the public on 15th January 2005. The school is built on eighteen acres land standing **on the vicinity of a huge, ancient Baobab tree estimated to be 200 years old,** beautiful and a hilltop overlooking the Indian Ocean along Dares Salaam - Bagamoyo Road.

2.31 Ethos and Curriculum

The intake of the school is inter-denominational and multi-cultural in character and committed to Tanzanian National Curriculum. BSS vision is to educate women who at the end they can work independently in the society. Subjects taught in four-year Ordinary level curriculum are History, Mathematics, Geography, Civics, Swahili, English, Biology, Chemistry, Physics, Commerce, Bookkeeping, ICT and English literature. For A level the two-year Advanced program, students major in either of six combinations EGM, ECA, HGL, HGK, HGE and HGM. The student's enrollment has grown from less than 200

students, in year 2005 to the current 650 students, and total enrollment is expected to reach 700 students by the start of year 2009.

2.32 School Facilities

The main facilities in the School include dormitories, classrooms, laboratory, Kitchen, Dining Hall, Multipurpose Hall, library, Senior and junior Staff quarters. The compound is vast, and provides study sites, gardens, play grounds for football, netball, etc. Most of the students come from Tanzania and few transfers from Uganda, Kenya, Botswana and the UK.

2.33 Single Sex Education for Security

BSS is exclusive boarding school for girls because historically, single sex education has shown excellent performance for some time now.

2.34 School Official Inauguration

His Excellency, the President of United Republic of Tanzania Mr. Jakaya Mrisho Kikwete officially inaugurated the school on 10th March 2007. The inauguration by the highest office in the country brought about to our school community new impetus and zeal to fight poverty – the number one enemy of our country.

3 BACKGROUND OF THE ENERGY PROJECT

3.1 OBJECTIVES

- To replace firewood with biogas and solar energy in **Baobab Secondary School**,

- To pilot a renewable energy system that integrates use of sewage, cow dung, plant regenerative part (leaves), and solar energy and assess relative contribution for possibility of replication in more Schools in the country,

- The installation to serve as practical demonstration units to students, research institutions, and general public on the way renewable energy can supply sustainable energy for local needs, and mitigate the adversities of climate change.

3.2 PROBLEMS TO BE SOLVED

The School requires 65m^3 of firewood for cooking per month, and 650m^3 per year at a cost of 2.6 million Tshs per month and 26 million shillings per annum.

Given that there are more 3300 Secondary Schools in the country, the amount of fuel wood consumed in one year is 2,145,000m^3, which corresponds to alarming deforestation depending on density of useful wood on the land. Every new School adds new demand on the diminishing wood stock as the conventional source of energy like electricity, bottle gas, and kerosene is too expensive.

Clearing of woodland in this way leads to soil erosion, shortage of wood for construction, land degradation (soils loosing the sponge effect of holding and releasing moisture slowly), reduced agricultural productivity, siltation in dams and reduced potential of supplying electricity, and ultimately heightening poverty in the agricultural sector. In this respect, alternative and sustainable solutions have to be sought after, and best if such can supply adequate energy with spin-off that simultaneously supports agricultural production.

Among sustainable energy possibilities, exploitation of biomass and solar energy is what seems to be most practical and effective in baobab Secondary School. Existing biomass in the form of toilet and livestock waste can be processed in anaerobic plants to generate gas fuel and safe organic manure for crop production; solar energy can be used to preheat water for kitchen applications like cooking and washing utensils.

The School Sewage (from toilets and livestock) will generate a maximum of 67% of cooking fuel (see part 4.2); the remaining deficit (33%) will be supplemented

with solar hot water, and by adding fast biodegrading plant matter into the bio-digesters.

3.3 STATE OF THE TECHNOLOGY

3.31 BIO-DIGESTERS AND APPLIANCES

During 2000 and 2007, the technology of treating organic waste, and in Particular toilet waste in a large scale has attained outstanding achievement in the world in two respects, namely; (i) retaining methane bacteria longer in the bio-digester for enhanced bio-degradation process, (ii) making it possible to build biogas plants in modules of any scale. The development period has also availed small, medium, and large-scale gas stoves suited to households and institutions.

By use of this design in the Tropics, School and prison sewage can generate up to 70% of fuel energy required for cooking. However, 100% cooking energy sufficiency is possible by extra sources of organic matter and use of solar energy.

A biogas system is free of bad smell because it's built underground, the effluent is safe and a better fertilizer for crop production, and the gas flows from plant to kitchen by own pressure. On the basis firewood cost in the urban, such biogas systems have a payback period of 3 to 5 years, operational life of 50 years, and an annual maintenance cost of 1.5% of initial investment.

3.32 BIOGAS

Biogas is mainly a mixture of methane (CH_4)- which burns, and carbon dioxide (CO_2), which does not burn. Minor contents in biogas are hydrogen sulphide (H_2S), water vapour (H_2O), and nitrogen.

Biogas is generated when methane-bacteria act on organic matter in moist and airless condition. With methane content of 50% or more, Biogas burns with a blue hot flame. However, depending on the nature of feedstock, duration of anaerobic process, and temperature, the content of methane may rise up to 65% by volume.

When derived directly from plants (vegetation), biogas contains more methane and much less H_2S compared to animal waste. For this project, a plot of fast growing perennial plant shall be established close by, as source of supplement biomass to the biogas plants.

3.33 SOLAR WATER HEATING

Solar power is available in the tropics in the tune of 1,000W/m^2 and above, lasting for 4 to 6 hours. Out of this, electricity panels generate much less useful power, but comparatively however, solar collectors generate more useful energy in the form of hot water.

Instead of using water at room temperature (25 °C), preheating water by solar energy (to 80 °C) would substantially reduce pressure from energy sources such as wood and electricity; and the advantage of it is that, solar collectors and hot water are available on the market, and the expertise for installation and maintenance exist too.

3.4 PROJECT OUTPUTS

i) Replacement of firewood with superior and sustainable energy in Baobab Secondary School, and allow for regeneration of woodland. The School will save 45m^3 of firewood per month, and 450m^3 per year,

ii) The project will serve as learning ground for students, similar institutions, practicing engineers, and general public on the way local resources can be harnessed to solve existing energy and environmental problems, and in the process, recover organic manure for crop production. Currently, there are 2,500 Secondary Schools in the country, and were the scheme adopted all over, it would save at least 1,125,000 m^3 of wood annually and thus sparing a remarkable acreage of woodland,

iii) Members of staff and students shall have the opportunity to familiarize with this important project on use of renewable energy resource use,

iv) Provide educative ground for form IV and VI students for their final year research projects,

v) Annually avail 360 tons of conditioned organic manure required for 15 Ha of farm/cropland owned and operated by the school and producing organic fruits and vegetables.

vi) The produce from farm will provide ingredients for the school refectories, offering a varied organic menu. It also intended serve as a "natural" classroom for the girls to study, horticulture and nutrition as well as domestic science, hospitality and catering.

vii) Obtain planning tools for replication of the project in areas of similar conditions and energy requirement.

4 PROJECT COMPONENTS AND PLAN

Each project component (biogas plants, vegetation plot, and solar water heating unit) will have provision for separate and joint measurements. Data collection will include weather elements, biomass yield (of the plot), productivity of gas from biogas plants, and from laboratory-scale bio-digesters.

4.1 VEGETATION-BASED BIOMASS

Half a hectare land will be planted with a study plant of fast growth and substantial biomass yield record. The trial plot is located at 200m from the designated biogas plant site, and is a convenient point to reach and feed the biogas plant.

4.2 SEWAGE AND ANIMAL WASTE

Existing biomass sources in the School

S/n	Source	Number	Weight: kg/day	Gas: m^3/day
1)	People	650	325	39.0
2)	Cows	60	600	48.0
3)	Goats	150	150	12.0
4)	Chickens	250	20	1.2
	Total			100.2

On the basis of $1m^3$ of biogas for 4 persons (cooking fuel requirement) per day, the gas fuel sufficiency will be about 67% for 600 students. (At present there are 400 students on Campus, and will be 600 by year 2008) The fuel energy deficit (33%) shall be offset by addition of vegetation-based biomass into bio-digesters, but also having pot water preheated on solar energy.

Sewage will be re-drained from all toilets in the compound (of students and staff) – bypassing septic tanks and soakages – towards the bio-digester unit 1. However, there will be a separate feeding provision for additional feed, such as food leftovers and the vegetation material.

All livestock waste (cow dung, goats/sheep shit, and chicken manure), as well as vegetation materials will be directed into Bio-digester unit 2 – situated at 500m away from Bio-digester Unit 1, 200m away from the vegetation plot, and 600m away from the School kitchen (see Annex 2 for installation layout).

The effluent will be separated into water and solid parts for subsequent treatment and utilization.

4.3 BIOGAS UNITS

Bio-digester Unit 1:
On the basis of toilet discharge of $6.5m^3$ of waste/day, and ground temperature of 25°C in Dares Salaam, a retention time of 25 days – corresponding to $75m^3$ x 2 bio-digesters is adopted.

Bio-digester Unit 2:
The biogas unit will feed on farm sewage (from livestock and toilets) and vegetation material. A digester volume $75m^3$ is recommended in view of liquid waste discharge, and basing on the retention time of 25 days.

4.4 SOLAR WATER HEATING UNIT

The amount of water to be pre-heated (25 – 80 °C) is 600 liters by $2m^2$ x 6 solar collectors: one liter per student for food preparation and washing utensils.

5 PROJECT COSTS AND PAYBACK PERIOD

The project costs are shown in appendix A1 below to this report. The project cost stand at Tshs 69, 354,500/= (US Dollars 55,484) of which school can raise internally 15% of the total project cost equal to Tshs 10,403,175 equal to US Dollars 8,322. The rationale for the project costs is evident, considering that the school incur annually cost of about 22.5 million to procure 450 cubic meters of firewood. At these costs the project pay back period oscillates around 3 years.

6 MILESTONE

The project implementation time frame is 9 months from the start as shown in process activities in appendix A2 below to this report. Definitive implementation plan will be drawn when funds are secured.

7 MANAGEMENT

SSA Board of Directors shall sign a contract with the donor to oversee the funds and shall open a separate bank account for this purpose and provide quarterly, half yearly annually, and audited reports to the donor/financer.

The CEO shall sit on regular project steering committee meetings with the donor, provide progress reports, financial and physical, and educational progress of the project as outlined in the objective section.

Project Costs **Appendix A1**

	A) **Cost estimates for biogas plants (75 cum x 2; 30cum x 2),**		**75cum x 3**		
	(for sewage, livestock and vegetation material)				
					TSHS
S/n	**Item**	**Unit**	**Quantity**	**Unit price,**	**Sub total,**
1)	Bricks (cement sand)	pcs	60,000	130	7,800,000
2)	Sand,	t	84	11,000	924,000
3)	Cement,	bags	750	13,000	9,750,000
4)	Lime,	bags	90	6,000	540,000
5)	Water proof cement,	kg	90	2,000	180,000
6)	Coarse aggregates _ + 1”,	t	63	16,000	1,008,000
7)	PVC 6” (Class B)	pcs	2	80,000	160,000
8)	Chicken wire,	m	700	1,500	1,050,000
9)	Steel: 16mm,	pcs	50	20,000	1,000,000
10)	Steel: 12mm,	pcs	20	13,000	260,000
11)	Steel: 6mm, roll (300m)	roll	1	170,000	170,000
12)	Welded mesh (BRC),	pcs	30	9,000	270,000
13)	Binding wire, 2mm,	kg	25	1,500	37,500
14)	Form work: timber				
	(4’’ x 2’’), plywood, mould				1,500,000
15)	Nails, 1_” – 4”	kg	20	2,000	40,000
16)	PVC 1_” Class B: gas line from plants to kitchen, roll (each roll 150m)	roll	3	470,000	1,410,000
17)	Galv. pipes 1”: plumbing indoor	pcs	5	35,000	175,000
18)	Gas burners				0
19)	for 100-liter	pcs	2	250,000	500,000
20)	for 200-liter	pcs	2	300,000	600,000
21)	Fittings				3,500,000
	Laboratory-scale bio-digesters for parallel studies (correlation)	no	10	200,000	2,000,000
22)	Labour for gas plumbing				2,000,000
23)	Labour for biogas plants 75cum	unit	3	3,500,000	10,500,000
	Total 1				**45,374,500**
	B) Cost estimates for sewage drains				
	(from toilets to Bio-digester Unit 1 and overflow)				
	Item	**Unit**	**Qty**	**Unit price,**	**Sub total,**
1)	Excavation and soil backfill	m	180	2,500	450,000
2)	PVC 160mm, class B	pcs	30	96,000	2,880,000
3)	Inspection chambers	no.	15	40,000	600,000

4)	Plumbing labour	m	180	5,000	900,000
	Total 2				**4,830,000**
	C) Cost estimates for solar water heating				
	Item	**Unit**	**Qty**	**Unit price,**	**Sub total,**
1)	Hot water tank: 1,000l	no.	1	3,000,000	3,000,000
2)	Solar collectors:2sqm	no.	10	500,000	5,000,000
3)	Mounting frame	no.	1	1000000	1,000,000
4)	Connecting pipes 1" and				0
	Insulation	no.	20	40,000	800,000
5)	Fittings				600,000
6)	Transport to site				500,000
7)	Installation labour				1,500,000
	Total 3				**12,400,000**
	D) Establishment of trial plot, 0.5Ha				
	Item	**Unit**	**Qty**	**Unit price,**	**Sub total,**
1)	Plowing, harrowing, Ha		0.5	500,000	250,000
2)	Seedlings	no.	3,000	500	1,500,000
3)	Planting		3,000	50	1,500,000
4)	Weeding: 6 times/yr		6	250,000	1,500,000
5)	Contingency				2,000,000
	Total 4				**6,750,000**
	Grand total: 1 to 4			**Tshs**	**69,354,500**
	Exchange Rate to US Dollars is	**Usd 1**	**Equals**	**Tshs 1,250**	
	Total project costs Usd				**55,484**
	Funds requested			**US Dollars**	**47,167**
	Project self financing			**US Dollars**	**8,322**

8 MILESTONE

Appendix A2

	Item	Month								
		1	2	3	4	5	6	7	8	9
1)	Refined and final site planning									
2)	Site mobilization for project components: biogas, solar, and trial vegetation plot									
3)	Excavation works for biogas plants									
4)	Fencing and preparation of trial vegetation plot: plowing, harrowing…									
5)	Supply solar equipment, install in place, connect to kitchen									
6)	Supply building materials (for biogas) to site									
7)	Organize labour, tools, and work schedules									
8)	Complete foundation of biogas plants									
9)	Construction of biogas plants, soil backfill, landscaping									
10)	Installation of sewage drains from toilets to bio-digesters: excavation, plumbing, inspection chambers, backfill									
11)	Planning, designing and construction of laboratory-scale bio-digesters + data collection									
12)	Plumbing of gas lines to kitchen and laboratory									
13)	Guided visits to project site by staff and students									
14)	Solar water heating, biogas plants, and appliances in place, trial plot with desired vegetation and studies progressing									
15)	Project commissioning + M &E quarterly									
16)	Quarterly project progress report (to School Director/donor)									