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Qualitative Assessment of Energy Initiative: Case Study from Liberia

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ABSTRACT: In policy domain, economics is concerned with decision about the best alternative for undertaking public and private initiatives. Economic decision is a complex issue since many explicit and implicit economic factors affect the available economic alternatives. This is particularly difficult when we have to decide about launching an energy initiative. Generally, economic options are quantitatively evaluated using cost benefit analysis method which considers only explicit factors and does not cater for the opinion of masses about suitability of particular economic option. This shortfall of quantitative assessment is more pronounced in case of energy initiative for which the ultimate recipients are the masses and undertaking of energy initiative has to cater for the consent of the masses. The opinion of people gives important conclusions about explicit and implicit factors affecting the economic options. Thus, for launching an energy initiative, it is more prudent to go for qualitative participatory assessment procedure rather than rigid cost benefit analysis. In 2009, Government of Liberia decided to invest in an energy initiative to generate energy for the diverse consumption. In this case studydiscusses qualitative economic evaluation of three different options considered for the energy initiatives. The study was aimed at finding the relative feasibility of available options based on the opinion of people. For this purpose, instead of using cost benefit analysis method, ItemizedScale survey technique was used to ascertain the economic feasibility of options. Case study contains useful and pertinent policy lessons for implementation.

Keywords: Economics; energy; initiative; Itemized Scale; survey
JEL Classifications: O22; O55; Q42; Q48.

1. Introduction

Economics is concerned with selection of best alternative or option for undertaking economic initiatives. Selection of best alternative which fulfill socio-economic and environmental needs is the prime task of economic planners and this is very important aspect in the context of economic decision making. Economic decision making is not a simple affair as many explicit and implicit socio-economic factors affect economic alternatives and we need to consider these factors while deciding about the best option. Moreover, each initiative has direct or indirect linkage with the masses as they are the ultimate beneficiaries or sufferers of the initiative undertaken. Thus, economic decision making is a complex policy issue in the modern era, while it has to satisfy the quantitative formulae on one hand, it has to take care of the numerous explicit and implicit factors as well as opinion of masses on the other hand. Hitherto, economic options are quantitatively evaluated, mostly using cost benefit analysis (CBA) which considers only explicit factors in monetary terms and does not cater for the implicit factors such the social, ethical and environmental aspects. Since, the evaluation of implicit factors is not possible with the quantitative evaluation method, some appropriate new method of evaluation was required to be devised which would cater for both explicit and implicit factors with due cognizance of opinion of the population. Total reliance on quantitative evaluation may render the initiative unfeasible in the long run due to implicit considerations. Therefore, a need was felt to

develop a versatile and comprehensive framework and construct a factor matrix for the economic evaluation of the alternatives so as take a prudent economic decision, taking care of all explicit and implicit factors as well as opinion of the population of the area.

To conduct the qualitative assessment of energy initiative of Government of Liberia, a multi-prong comprehensive research methodology was adopted. First the socio-economic factors affecting the three alternatives were selected and a factors matrix was constructed; this matrix included both explicit and implicit factors. Based on these factors, a questionnaire for collection of the opinion of people was formulated. Itemized Rating Scale (IRS) method was used which is a survey technique based on rating scale approach. In this method, suitability or unsuitability of each economic factor was ranked by respondents on a five points scale as 1, 2, 3, 4 & 5. For example a respondent's opinion about the location of the initiative was represented by 1, 2, 3, 4 & 5 (representing bad, slightly good, good, better, best respectively). Opinion of people was collected through the formulated questionnaire. To substantiate the evidence, field visits and selected interviews were also conducted in the area where the initiative was undertaken. The data obtained through questionnaires, interviews and field visits was analyzed. Based on the results, comparative economic feasibility of the alternatives for the initiative was concluded.

This research describes how the economic evaluation of an energy initiative is carried out to ascertain the economic feasibility and worthiness. It also shows the significance of economic evaluation in the context of social suitability, as ultimately every initiative effect members of society, either negatively or positively. Environmental and ethical aspects were also considered for evaluation of the alternatives.

2. Literature Review

In-depth study of existing literature on the subject was carried out, however, since the subject of research was new, the literature was found minimum in quantum. Few researchers around the globe have highlighted the need for revision and updation in thetheory of economic evaluation, but none of them could be sighted for making an attempt doing it.

Economic decision making is an intricate phenomenon. This decision is dependent on thorough evaluation of available alternatives; both public and private. Success of an initiative depends on host of explicit and implicit factors which influence the available alternatives. These factors are required to be evaluated to conclude the overall feasibility of a particular alternative.

An economicalternative is an availableoptionforimplementation (Gul, 2013). Alternative has also been defined as a set of proposals, possible operations, methodologies, etc. For achieving goals, objectives, or accomplishing a task (Thuesen, 2002). In a particular economic environment, we are confronted with one or more than one economic alternatives and we have to select the best alternative for implementation out of the available. Itshould be notedthatalternative is a standaloneoptionthat can be adopted (Baumol, 1977). This is a very critical decision. If a wrong alternative is selected for implementation, the society suffers instead of getting benefits.

It is universal fact that there is scarcity of resources because of which we need to make choices and select the best. Economic decision making is based on comparison of the alternatives through economic evaluation (Boardman, 2006). Economic evaluation consists of three parts; economic analysis of alternatives, deducing economic feasibility of each alternative and ultimately selecting the best alternative (Kurtz, 1995). Economic evaluation is determined by considering the explicit and implicit socio-economic factors influencing the alternative (Kleinfeld, 1998). It is evident that socio-economic factors impact the overall cost and life of the initiative. Ignorance to wholesome economic evaluation of available alternatives can be detrimental to the initiative undertaken (Keeney, 1993).

Economic evaluation is a process through which we assess and analyze the economic factors toconclude about an economicactivity (Jafari, 2010). It is the detailed analysis of each economic factor influencing the economic activity. Through economic evaluation, the available alternatives are compared and the best alternative is selected (Mishan, 1970). Traditionally we use cost-benefit analysis for evaluation of economic alternatives, though there are other secondary methods available which are exact and rigid in nature and none of these considers the social, ethical and environmental considerations (Richardson, 2000).

Theconcept of CBA datesbackto an 1848 articleby Jules Dupuit and was formalized in subsequent Works by Alfred Marshall (Arrow, 1970). The USA Corps of Engineers initiated the formal use of CBA in the US in 1936 for proposed federal infrastructure. It demanded that the benefits to be in excess of theestimatedcosts (Weisbrod, 1981). An early and often-quoted, more developed application of the technique was made to London Underground Victoria Line (Foster, 1963).

Weighing the total costs against the total benefits in order to choose the best or most profitable option is often referred to as CBA (Cost-Benefit Analysis). Cost-benefit analysis is used for two purposes; to determine the feasibility of an initiative (investment decision or government policy), and to compare the competing alternatives of the basis of costs and benefits. CBA is relatedtocost-effectiveness analysis (Sen, 2000). In CBA, benefits and costs are expressed in monetary terms, and are adjusted for the time value of money, so that all flows of benefits and costs over time are expressed on a common basis in terms of their net present value (Dasgupta, 1972).

CBA is a quantitativeanalyticaltooltoaiddecision-makers in ascertaining the feasibility of available alternatives (Chakravarty, 1987). It identifies and attempts to quantify the costs and benefits of a programme or activity and converts available data into manageable information (Boardman, 2006).

Cost–benefit analysis is often used by governments and other organizations, such as private sector businesses, to evaluate the desirability of a given policy. It is an analysis of the expected balance of benefits and costs (Zeleny, 1982). CBA helps predict whether the benefits of a policy outweigh its costs, and by how much relative to other alternatives (i.e. one can rank alternate policies in terms of the cost-benefit ratio). An analyst using CBA should recognize that perfect evaluation of all present and future costs and benefits is difficult, and while CBA can offer a well-educated estimate of the best alternative, perfection in terms of economic efficiency and social welfare are not guaranteed (Hammond, 2002).

CBA usually tries to put all relevant costs and benefits on a common temporal footing using time value of money calculations (Tang, 1986). This is often done by converting the future expected streams of costs and benefits into a present value amount using a discount rate. The choice of discount rate is subjective (Tang, 1988). The choice makes a large difference in assessing interventions with long-term effects, such as those affecting climate change (Kurtz, 1995).

After this brief literature review, I will now explain the problems in existing methods of evaluation with reference to cost-benefit analysis.

3. Problems in Existing Methods for Evaluation of Economic Alternatives

Current methods of analysis, particularly the value of a cost–benefit analysis depends on the accuracy of the individual cost and benefit estimates. Comparative studies indicate that such estimates are often flawed. Causes of these inaccuracies are enumerated below.

- Overreliance on data and arithmetic. Mere quantification of the costs and benefits in monetary terms, disregarding social, environmental and ethical considerations, may be misleading in the modern era (Gul, 2013).
- Inability to consider the cost and benefits of the intangible or implicit factors (Raffia, 1997).
- Does not cater for the opinion of masses (non participatory).
- Exactness and rigidity in approach (Hendrickson, 1985).
- Only rank the alternative as feasible and unfeasible. What if there are more than one feasible alternative? Which one will be selected? Feasible alternatives can be good, better, best (White, 1998).
- Lack wholesomeness and comprehensiveness.
- The choice of discount rate is subjective.
- Does not evaluate, only analyses the available alternatives in exact terms.
- No mechanism to value the social, ethical, environmental and climate impacts (Gul, 2010).
- Neglects socio-economic welfare aspects (Prest, 1965).
- It does not consider the possibility of trade-off between the elements when both the costs and benefits of the alternative are high or lower. Costs and benefits are relative to the

economic conditions (Collier, 1999). What if a cost of a particular initiative is half the country's budget and benefit is slightly more than the cost? The cost-benefit analysis will declare it as feasible alternative, but is it really suiting that country? Hence, there is need for trade off between costs and benefits. This is indicated in the analytical matrix shown in figure 1.

Figure 1.Analyticalmatrix of cost-benefitanalysis

	Benefits Lower	Benefits Higher
Costs Higher	Reject	? (trade-off is required here)
Costs Lower	? (trade-off is required here)	Accept

The main problem with cost-benefit analysis is that it requires translation of all value of a given proposal into monetary terms (Bierman, 1984). Because the cost-benefit approach uses monetary value as a universal metric, they say, it is a neutral tool. But quantitative analyses are never neutral (Richardson, 2000). To be useful, any data, including economic data, must be considered in the context of the decision that is being made. Also, no matter how clever the mathematics, certain key inputs in a cost-benefit analysis cannot be translated into monetary value. Security and safety, the preservation of environment, technological innovations, social and ethical aspects are all economic intangibles and omitting them when they are clearly important factors should invalidate the analysis (Brealey, 1984). There exists a strong presumption that an act should not be undertaken unless its benefits outweigh its costs. This at times may conflict with social welfare and ethical phenomena (Neumann, 1944). The monetary benefit of an initiative may overcome the costs, it may still be morally and ethically wrong. Prostitution can be quoted as an example.

4. Research Methodology

Considering the wide scope and diversity of the topic, a multi prong comprehensive systematic methodology was adopted to conduct this research. Specific steps are enumerated below.

- **Step 1**. Detailed review of the existing literature (already discussed in section 2).
- **Step 2**. Development of factors matrix for evaluation.
- **Step 3**. Selection of suitable scale.
- **Step 4**. Formulation of questionnaire to collect opinion of population.
- **Step 5**. Data collection through field visits, interviews, and questionnaires.
- **Step 6**. Data analysis and results.
- **Step 7**. Conclusions.

Step 1 regarding review of existing literature has been covered at length in section 2. Rest of the steps will be explained one by one in detail.

5. Development of Factors Matrix

Selection of suitable socio-economic factors for evaluation was the most important step of the research. All relevant explicit and implicit factors influencing the alternatives were required to be included in the matrix. After detail and in depth study, a factors matrix was developed which is shown in table 1. An alternative which meets the socio-economic factors of the matrix optimally shall be preferred over the others.

Table 1. Factors Matrix for evaluation of the alternatives

Socio-economic factors	Description
Cost of material and resources	Cost of material is always a variable. Material may be required for construction, production or resources employed for implementation of the policy.
Availability of material and resources	If material and resources are not available, it will have to be arranged from a far off distance or may have to be imported from another country which will involve expenditure, increasing the cost manifolds.
Availability of desired workmanship	Itneedsto be seen whether there quired labour or employees are available locally or they have to be shifted from far off distance. If the employees, especially managerial level and below, have to come from far off distance, then boarding and lodging facilities will have to be developed which will increase the costs.
Work specialists	Salaries and wages of the work specialists at all level is an important consideration. If the work specialists are available at lower salaries, this will accrue considerable economic benefits.
Non specialists	A sizeable portion of the employees will be non specialists. If these non specialists' workers are available at low salaries, this will also add to the economic benefit.
Working hours	The more the working hours, the more the work. More working hours ensure optimum usage of the human capital.
Transportation costs	If the material is required to be shifted from some other area or country through road, rail or air, it will increase the costs. Transportation costs can also be interpreted as the costs incurred on transportation of raw material from some other area to the location of initiative and costs incurred on transportation of finished product from location of the initiative to the market.
Maintenance costs	The short and long term maintenance costs have great impact on the overall feasibility of different alternatives.
Costs due to climatic conditions	Maintenance costs will increase if an alternative is located in heavy rainfall zone, flood plain or seismic zone. Global warming has effect on the development and maintenance costs.
Environmental effects	Initiatives may have positive or negative environmental effects. Thenegativeeffectssuch as airandnoisepollution, smoke, chemicals, sewerage, impuritiesetc reduce the feasibility of an alternative in modern era, even if the costs are less.
Social effects	If a socio-economic initiative has adverse social effects, it should not be undertaken, even if the costs are less. An alternative should be declared feasible if it is socially plausible and ensures social welfare.
Ethical and moral effects	There are initiatives, such a prostitution, which has zero costs and maximum profits, but are not suitable ethically and morally. The ethical and moral considerations may supersede all other considerations, depending on the ethno-religious fiber of the society.
Location	Many economic initiatives are rejected due to bad location. Accessibility to road, rail and air network facilitates transportation to and from the location of initiative. Location of the initiative has direct relevance to the overall costs.
Employment opportunities	Is the initiative creating some employment opportunity for the population? If it is creating, this will increase the benefits and social welfare of the local populace.
Profitability / revenue generation	Economic alternative should ensure desired profitability and intended revenue generation. If it is considered as below the intended profitability and revenue generation, then some other alternative should be selected. However, contrary to the traditional cost benefit analysis, this is the only criteria for selection of an alternative.
Capital / technological costs	Every alternative will require some technological and capital investment. The cost incurred on such paraphernalia should be less. However, no compromise on the quality of capital, equipment and technology should be

	accepted to avoid long run maintenance costs.
Land costs	Land may be required for many purposes. For main site, internal network, residences, offices, warehouse, stores and waiting area etc. Moreover, economic policy initiative may involve compensation for the land acquisition. Land cost and revenue both should be critically ascertained.
Infrastructural development	Even the smallest economic initiative or policy action will require infrastructure development. Internalroads, paths, buildings, papers, multimedia, hall set care the common requirements. These costs should be kept minimal and endeavour should be made to select the alternative with minimum infrastructure development requirement.
Law and order	Law and order and security situation in the area where initiative is being undertaken should be critically viewed. It should be analyzed whether is the deteriorated security situation is temporary or will remain existent for considerable period of time. Are the workers working for a particular social or economic initiative safe and free to work?
Aesthetics	The socio-economic initiative should not cause disturbance, rather should preferably add to the beauty of the environment.
Timeframe of implementation and completion	The lesser the time for implementation and completion of the policy initiative, the better it is. Results of the socio-economic initiative should be visible soon after its implementation.
Design life	Design life should be more. Life cycle cost and maintenance requirements should be less for the alternative to be best. An alternative with maximum design life, but more maintenance requirement should be avoided.
Sustainability	The selected alternative should be sustainable in nature. Without sustainability, an alternative may not give the desired benefits.
Fulfillment of intended purpose	Is the alternative fulfills the intended purpose? Is it beneficial for the population? Is it ensuring social welfare of the people? All these aspects need to be assessed to select the best alternative.
Potential for expansion	Initiative should have potential for further expansion with minimum costs. However, this is an added advantage and is not a guiding criterion.
Local and foreign recognition and acceptance	If the initiative has foreign recognition and acceptance, it may act as magnet for foreign investors and this will increase the benefits considerably. However, this is an added benefit and not the deciding criteria. An initiative which has local acceptance and ensures the socio-economic welfare of the society should be considered as feasible. The initiative undertaken should be within the laws and legal rights.

6. Scale of Assessment

Three types of scales were considered as per the economic measurement procedure; the measurement scale, the rating scale and the ranking scales. The measurement scale was not considered suitable due to nature of the data as it was difficult to quantitatively measure few socio-economic factors such as social, ethical and environmental effects. Similarly, ranking scale was also not appropriate since it was not intended to rank the socio-economic factors of evaluation matrix; rather rating of these factors was required. Therefore, rating scale was adopted for this research. Considering the nature of data involved, the Itemized Rating Scale was used for assessment of these socio-economic factors. In this scale anchor is provided for each item and the respondent state the appropriate number on the side of each item. It was decided to use five points scale of 1, 2, 3, 4 and 5 to rate the socio-economic factors of evaluation matrix. The description of the scale, its meaning and arithmetic range is shown in table2.

Table 2. Description of the Itemized Rating Scale, its meaning and arithmetic range

Scale	1	2	3	4	5
Meaning	Bad	Slightly Good	Good	Better	Best
Range	1 to 1.99	2 to 2.99	3 to 3.99	4 to 4.99	5 to 5.99

7. Formulation of Questionnaire

An easy, crisp and user friendly questionnaire was designed. It comprised 26 simple questions about the 26 economic factors listed in the factors matrix at table 1. People sample had to answer in terms of given rating scale depending on their satisfaction or opinion about a particular economic factor. Specimen of questionnaire is shown in table 3.

Table 3. Specimen of questionnaire

Name:	Occupation:				
Location:	Age:				
Please tick suitable box under the number for each factor					
Socio-economic Factors	1	2	3	4	5
Cost of material and resources					
Availability of material and resources					
Availability of desired workmanship					
Work specialists salaries / wages					
Non specialists salaries / wages					
Working hours					
Transportation costs					
Maintenance costs					
Costs due to climatic conditions					
Environmental effects					
Social effects					
Ethical and moral effects					
Location					
Employment opportunities					
Profitability / revenue generation					
Capital / technological costs					
Land costs					
Infrastructure development					
Law and order					
Aesthetics					
Timeframe of implementation and completion					
Design life					
Sustainability					
Fulfillment of intended purpose					
Potential for expansion					
Local and foreign recognition and acceptance					
	Date:		Signature:		

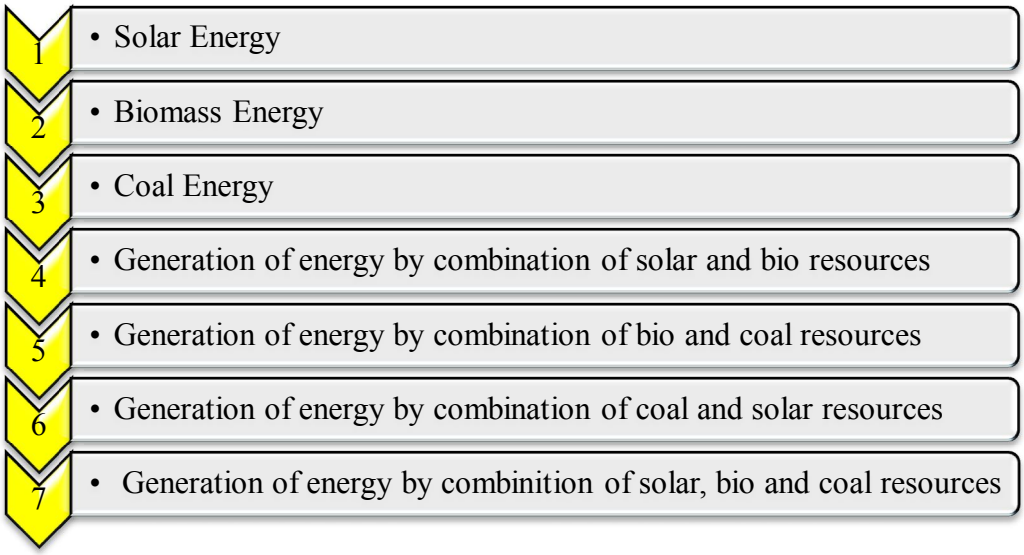
8. Energy Initiative by Government of Liberia

The Government of Liberia needs 8500 Megawatts of energy for its capital Monrovia, whereas the available is 4800 Megawatts; so, there is a gap of 3700 Megawatts. To fill this gap between demand and supply, Government of Liberia wanted to undertake an energy initiative to facilitate inhabitants of its capital. For this purpose the proposed budget allocation was US$ 3 Billion. Following alternatives were considered for this initiative.

- Solar energy.
- Biomass energy.
- Coal energy.
- Any combination.

Seven alternatives were formed for this initiative as shown in figure 2.

Figure 2. Alternatives available for the energy initiative of Government of Liberia

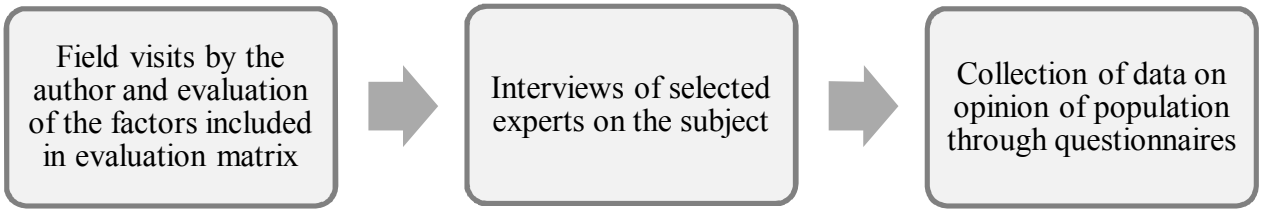


Government of Liberiawanted to conduct economic evaluation of the above alternatives for energy initiative. Since the energy was to be used by domesticconsumers, especially households, opinion of experts and common people of the subject was of value.

9. Data Collection Process

Comprehensive data collection process was adopted for economic evaluation of the above alternatives so that the best alternative could be selected for implementation. The technical feasibility of all the alternatives was already established. Only the economic evaluation was required to assess the economic viability. Thescheme of data collection for the economic evaluation is shown in figure3.

Figure 3. Data collection process



Fieldvisitstolocation of each alternative were made by the author to ascertain the prevailing factors included in the evaluation matrix. During these field visits, following steps were undertaken.

- Comprehensive filed visit plan was formulated spanning over three months, which included the dates, places, alternatives and people to be visited. A tentative filedvisit plan for a group of three alternatives is shown in table 4.
- Each factor was discussed with experts as well as common people of area. Selected community leaders, technical experts, school teachers and investors in each area were involved in the process of discussion during filed visits.
- Their opinion was registered.
- Visits of the sites were conductedto match the people's response and on ground facts. Ongoing development projects and economic initiatives in the area were also visited. Area was visited to know about the availability of resources, its cost and the charges of transport in case the resources were not available locally. Social, economic and environmental conditions were observed. Ongoing initiatives were visited to know about skilled and unskilled workers and their salaries and wages. Meteorological and climatic

conditions were observed to know about the length of day hours and its effect on the labour hours.

- Deduction about each factor and filling of evaluation matrix was done at the end.

Table 4. Field visit plan

Schedule	Alternatives		
	1	2	3
Mar 2009	Discussion with school teachers	Discussion with common people	-
	-	Discussion with community leaders	Discussion with common people
	Visit of initiatives	-	Discussion with experts
	Discussion with experts	-	Visit of initiatives
	Visit of initiatives	-	Discussion with community leaders
	-	Discussion with school teachers	Discussion with school teachers
	Discussion with community leaders	Visit of initiatives	-
	-	-	Discussion with school teachers
	Discussion with common people	Discussion with experts	-
		Visit of initiatives	
April 2009	Compilation of results		
May 2009	Finalization of results		

Similarly, interviews were conducted by the author in person. Total of 30 experts were interviewed for this initiative. Each factor of the evaluation matrix was discussed with experts and at the end they were requested for filling of the evaluation questionnaire which they did.

For the field survey, random sample of 50 individuals was selected for each alternative in this research. Generally for computing averages of factors and alternatives, sample of this size is adequate. The level of awareness in the population about the factors included in the evaluation matrix suggested that 50 individuals for each alternative could effectively represent the opinion of whole population. Sample configuration was kept mixed. It included people from all walks of life regardless of gender such as commoners, school teachers, investors, community leaders and technical experts. The mixed representation in the sample has catered for bias and error in the sampling.

A systematic process was adopted for distribution and collection of the survey questionnaire. Questionnaires were distributed to ten community leaders, investors, school teachers, experts and commoners. Questionnaires were distributed in different areas sequentially, but not simultaneously, because, the guidance for filling of the questionnaire was required to be given to the respondents by the author himself. After collection, these questionnaires were arranged in a sequence. Sequencing and categorization of the questionnaires was done as per following procedure.

- They were compiled as per the alternatives for initiative.
- Compilation for each alternative was done in following four heads.
  - Experts.
  - Community leaders.
  - Investors.
  - School teachers.
  - Commoners.

- Each head was properly tagged with the name of initiative, alternative number and data heads. Separate tags were used for both the initiatives.
- Each folder was titled with the name of the initiative.

10. Data Analysis and Results

In this research, data was handled statistically by adopting following steps.

- Data cleaning was done. Necessary and unnecessary information was separated. Missing information was highlighted for correction.
- Data obtained though, filed visits, interviews and survey method by questionnaires, was complied and tabulated.
- Descriptive statistics were found for each alternative.
- Average count for each alternative was calculated to select the best alternative, which was the alternative achieving the highest average counts on the Itemized Scale.

The trend was very interesting as for all the alternatives of the energy initiative. Different percentage of people gave different rating to the factors of evaluation matrix. The variation in the people's opinion for each alternative can be noted from the tables 5. Tabulation was done for the purpose to know highest percentage of population sample allocating a particular rating to the factors. The maximum percentage of population sample allocating a rating to a socio-economic factor actually represented the popular opinion. For example, if the 75% of population sample felt that cost of material and resources for an alternative is best (most economical) and rated it as 5, then that would mean that complete population rated it as 5.

Table 5. Evaluation matrix for alternatives

Socio-economic Factors	Alternative 1					Alternative 2					Alternative 3					Alternative 4					Alternative 5					Alternative 6					Alternative 7				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
	Rating of socio-economic factors by percentage of population sample																																		
Cost of material and resources	75	10	5	5	5	20	10	50	10	10	20	15	10	35	20	20	10	30	15	25	20	10	20	30	20	10	10	50	20	10	10	10	50	20	10
Availability of material and resources	10	5	45	20	20	10	10	20	50	10	10	10	25	40	15	5	50	15	10	20	10	10	10	50	20	20	20	45	10	5	10	20	20	45	5
Availability of desired workmanship	20	10	50	10	10	20	20	10	45	5	30	40	15	10	5	20	60	10	5	5	5	10	50	25	10	5	5	80	5	5	5	5	80	5	5
Work specialists salaries / wages	10	50	10	20	10	5	5	5	5	80	10	15	35	20	20	10	20	40	10	20	5	10	10	50	25	10	20	60	5	5	10	20	60	5	5
Non specialists salaries / wages	20	45	20	10	5	5	20	10	5	60	10	10	40	25	15	10	10	60	10	10	10	10	10	50	20	10	10	70	5	5	10	10	70	5	5
Working hours	5	5	5	5	80	10	10	70	5	5	30	15	40	10	5	10	10	10	60	10	5	10	50	25	10	20	10	20	30	20	20	10	20	30	20
Transportation costs	20	60	10	5	5	20	10	30	20	20	20	30	20	20	10	10	60	10	10	10	10	10	60	10	10	10	10	50	20	10	10	10	50	20	10
Maintenance costs	10	70	10	5	5	10	10	10	50	20	20	20	30	20	10	10	20	30	20	20	10	10	60	10	10	5	10	50	25	10	5	10	50	25	10
Costs due to climatic conditions	20	10	30	20	20	10	15	10	50	25	20	10	30	20	10	20	10	15	30	25	10	10	60	10	10	5	10	50	25	10	5	10	10	50	25
Environmental effects	10	10	10	50	20	5	35	20	20	20	40	20	20	10	10	5	10	50	15	20	10	40	10	20	20	10	15	35	20	20	10	15	35	20	20
Social effects	5	10	10	25	50	10	20	20	20	30	10	10	10	10	60	5	20	10	5	60	20	15	10	20	35	10	10	25	15	40	10	10	25	15	40
Ethical and moral effects	5	10	10	25	50	20	15	10	20	35	10	20	20	20	30	10	20	10	20	40	10	10	25	15	40	30	5	15	10	40	30	5	15	10	40
Location	10	20	20	30	20	10	10	25	40	15	20	15	10	35	20	10	10	10	60	10	30	10	15	40	5	20	10	15	30	25	20	10	15	30	25
Employment opportunities	20	10	30	15	25	30	40	15	10	5	10	10	25	40	15	10	10	60	10	10	10	15	35	20	20	5	10	15	20	50	5	10	50	15	20
Profitability / revenue generation	5	10	15	50	20	20	20	30	20	10	10	20	30	20	20	10	10	60	10	10	10	10	40	25	15	5	20	10	60	5	10	20	60	5	5
Capital / technological costs	60	20	10	5	5	5	20	10	60	5	15	35	10	20	20	10	20	30	20	20	30	10	15	40	5	10	20	40	10	20	10	20	40	10	20
Land costs	10	20	10	40	20	10	20	40	10	20	10	10	25	40	15	5	10	10	70	5	20	20	20	30	10	10	10	10	60	10	10	10	10	60	10
Infrastructure development	10	60	10	10	10	10	60	10	10	10	30	40	15	10	5	20	30	10	20	20	20	30	20	20	10	10	10	60	10	10	10	60	10	10	10
Law and order	10	10	10	10	60	10	10	10	10	60	20	15	10	35	20	10	10	10	20	50	25	20	15	30	10	10	10	10	60	10	10	10	10	60	10
Aesthetics	10	10	10	10	60	60	10	10	10	10	10	40	25	10	15	20	10	30	15	25	10	30	20	20	20	10	20	30	20	20	10	20	30	20	20
Timeframe of implementation and completion	10	20	20	30	20	10	20	30	20	20	30	15	40	10	5	5	10	50	15	20	10	15	35	20	20	30	15	40	10	5	30	15	40	10	5
Design life	10	15	35	20	20	5	10	50	25	10	20	20	30	20	10	10	20	60	5	5	10	10	40	25	15	20	20	30	20	10	20	20	30	20	10
Sustainability	10	10	40	25	15	20	10	30	20	20	10	20	30	20	20	10	20	40	10	20	10	20	30	20	20	20	20	30	20	10	20	20	30	20	10
Fulfillment of intended purpose	30	40	15	10	5	10	50	10	20	10	10	15	35	20	20	10	60	10	10	10	10	15	35	20	20	10	20	20	30	20	10	20	30	20	20
Potential for expansion	20	20	30	20	10	5	10	10	50	25	10	10	25	40	15	10	10	10	60	10	10	10	25	40	15	20	10	15	30	25	20	10	15	30	25
Local and foreign recognition and acceptance	20	20	20	30	10	5	10	10	50	25	10	20	20	30	20	10	10	10	60	10	10	20	20	30	20	5	10	15	50	20	5	10	15	50	20

After summation of the data, it was analyzed by using SPSS 22. Descriptive statistics and few econometric values were found to understand the trend and draw conclusion about the alternatives to be selected. This is shown in table 6.

Table 6. Data analysis for energy initiative, Government of Liberia

Socio-economic Factors	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7
	Solar	Bio	Coal	Solar & Bio	Bio & Coal	Coal & Solar	Solar, Bio & Coal
Cost of material and resources	1	3	4	3	4	3	3
Availability of material and resources	3	4	4	2	4	3	4
Availability of desired workmanship	3	4	2	2	3	3	3
Work specialists salaries / wages	2	5	3	3	4	3	3
Non specialists salaries / wages	2	5	3	3	4	3	3
Working hours	5	3	3	4	3	4	4
Transportation costs	2	3	2	2	3	3	3
Maintenance costs	2	4	3	3	3	3	3
Costs due to climatic conditions	3	4	3	4	3	3	4
Environmental effects	4	2	1	3	2	3	3
Social effects	5	5	5	5	5	5	5
Ethical and moral effects	5	5	5	5	5	5	5
Location	4	4	4	4	4	4	4
Employment opportunities	3	2	4	3	3	5	3
Profitability / revenue generation	4	3	3	3	3	4	3
Capital / technological costs	1	4	3	3	4	3	3
Land costs	4	3	4	4	4	4	4
Infrastructure development	2	2	2	2	2	3	2
Law and order	5	5	4	5	4	4	4
Aesthetics	5	1	2	3	2	3	3
Timeframe of implementation and	4	3	3	3	3	3	3
Design life	3	3	3	3	3	3	3
Sustainability	3	3	3	3	3	3	3
Fulfillment of intended purpose	2	2	3	2	3	4	3
Potential for expansion	3	4	4	4	4	4	4
Local and foreign recognition and acceptance	4	4	4	4	4	4	4
Descriptive Statistics							
Average	3.320	3.480	3.200	3.280	3.400	3.560	3.440
Mode	3	3	3	3	3	3	3
Median	3	3.5	3	3	3	3	3
Standard Deviation	1.243	1.104	0.951	0.919	0.809	0.706	0.703
Variance	1.545	1.218	0.905	0.845	0.654	0.498	0.494
Covariance	0.518	0.547	0.553	0.425	0.272	0.311	0.475
Cofidence Interval	0.478	0.424	0.366	0.353	0.311	0.271	0.270
Skew	-0.069	-0.281	-0.200	0.415	0.023	0.962	0.669
Kortusis	-0.984	-0.594	0.127	-0.329	-0.274	-0.151	0.490
Econometric Values							
Correlation r value (Pearson)	0.036	0.542	0.658	0.594	0.496	0.651	0.619
F value	0.558	0.462	0.865	0.527	0.502	0.982	0.006
t value	0.531	0.371	0.972	0.594	0.653	0.487	0.495

Descriptive statistics showed peculiar trends which are explained below.

- The mean of all the alternatives vis-à-vis the scale of assessment showed that these alternatives were good. None of these was better or best.
- The highest mean for single alternative was for the biomass energy generation. Therefore, if Government of Liberia wanted to undertake the initiative without combination, then they could start with biomass energy generation. Similarly, the highest mean for the combination of two alternatives was for the combination of solar and coal. This valuewas even better than the single alternative, which shows that Government of Liberia could go for combination of two alternatives; solar and coal. The combination of three alternatives was also turned out to be good and could be undertaken.
- The difference between mean, mode and median for all the alternatives was negligible.
- The standard deviation value for solar was high (1.24), followed by biomass (1.104). This showed that the data was more scattered around the mean in case of these two alternatives. The values for all alternatives lied within 68 to 95 % of the area under normal distribution curve (on either side of the mean).
- The values of variance and co-variance for the alternatives indicated a normal situation.
- The confidence interval was high for the solar energy and least for the combination of three alternatives.
- Data set of single alternatives had negative skewness which meant that its data set contained few high values. This proved that people were not satisfied with the single

alternatives. On the other hand, combination of alternatives had positiveskewness, which meant thatits data set contained few low values. It reflected that people were happy with combination of alternatives.

- Data set for all the alternatives had negative kurtosis value except for coal energy and combination of the three alternatives. This showed that the curve represented by these data sets was flatter than normal distribution curve. In other words, fewer observations clustered near the average and more observations populated the extremes.

For energy initiative of Government of Liberia, energy generation by combination solar and coal was priority selection, followed by generation of energy by biomass only and then energy generation by combination of all three resources; solar, biomass and coal. Summary of results is reflected in table7.

Table 7. Summary of results

Priority Selection	Energy Initiative, Government of Liberia
1	Alternative 6: Energy generation from combination of solar and coal resources
2	Alternative 3: Energy generation from biomass resources
3	Alternative 7: Energy generation from combination of solar, biomass and coal resources

11. Conclusion

If there are alternatives for an initiative, public or private, one has to select the best available alternative. For selection of the best alternative, economic evaluation is required. For economic evaluation of the alternatives we need an efficient method which should be based on all possible explicit and implicit socio-economic factors and also caters for the opinion of masses. This cannot be ensured by traditional cost-benefit analysis which is currently used for the economic evaluation. Therefore, to address this concern, a new qualitative method based on socio-economic factors matrix was developed for economic evaluation of the energy initiative of Government of Liberia. New method was applied and it proved to be efficient and reliable.

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