

**POVERTY ALLEVIATION PROGRAMME
THE ROLE OF ENERGY - PROSPECTS AND ISSUES**

**K. Sivasubramaniam
Ceylon Electricity Board
P O Box 540
Colombo- Sri Lanka.**

ABSTRACT:- In this article, the author attempts to show the difficulties in defining poverty and gives a brief look at the concept of the Janasaviya Programme (JSP) and the institutional arrangement for it. As an outcome of the JSP, the author argues that there should be an increase in consumption of Energy to satisfy the survival needs and the development needs. This could increase the need for Traditional Energy Sources (TES) or Conventional Energy Sources (CES), which he contends, need to be planned and controlled. The relationship between Energy and natural, social environment in the rural area is shown and the need for careful planning of rural Energy systems based on Micro-level Data is emphasised. The author cautions rural electrification by extending grid supply and examines new and renewable sources of Energy technologies that could be adopted in the rural areas. He contends that fuelwood will dominate the Energy sector of the rural areas for a long time.

INTRODUCTION

For 'Poverty', or for that matter for 'Poor', there appears to be no standard definition. "Some programmes sought to identify the poor with reference to land ownership; others identified the poor in terms of family income, some in terms of the level of employment; some identified the poor in terms of access to social amenities; some with reference to housing standards etc. depending on the nature and emphasis on each specific programme"[1].

A paper approved by the editorial committee of the Sri Lanka Energy Managers Association for publication in the SLEMA Journal. Paper number J29003.

"In the generally accepted definition, to be poor means not only to have a low income but also to be lacking in basic amenities such as education, health-care, shelter, safe water and sanitation"[2]. The report also adds: "Furthermore, a link between poverty and environment is increasingly recognised. Poverty causes environmental deterioration, which causes poverty". It is understandable, as human needs depend on personal, family and social activities, which necessitate the availability of certain quantities of material goods and creation of certain psychological, cultural and spiritual conditions, poverty cannot be defined by absolute quantitative norms but depends on the satisfaction of different socio-economic needs.

In any event, most activities undertaken to satisfy human needs calls for the use of Energy in some form or the other. There are also cases where scarcity of Energy has led to changes in food patterns, thus lowering the nutritional status as well as lowering health standards [3].

ENERGY POVERTY

Gerald Leach in his book titled "Household Energy in South Asia" introduces the term 'FUEL POVERTY' but does not attempt to give a definition. But he states that, "these trends point-up to two crucial links between Energy use and poverty. The first, that the poorest urban families spend more of their income on Energy than others. The second is that they are often forced into using the costliest fuel, because they cannot afford the equipment for cheaper and more efficient fuels. The first link seems to be universal". Interestingly, he also states that "most house-

hold Energy problems are reflections of poverty and lack of investment in the poor. They also impact hardest on the poor. They persist not because they are insoluble, but that they have not been addressed with sufficient seriousness and vigor..... Energy policies alone will not cure these distortions, but they need to be recognized and then acted directly in favour of the neediest groups in society".

An ILO Survey has indicated that "per capita requirements of Energy necessary to ensure a minimum standard of living, has been estimated at 325 kilogram of oil equivalent per annum. In Sri Lanka, the per-capita consumption of Energy is estimated to be within the range of 200 - 250 kgoe per annum [4]. Given the fact that 80% of Sri Lankans inhabit rural areas and that 1.9 million families are officially classified as poor (income less than Rs. 700 ie US\$17.5 at 1990 rates per month), it is not difficult to guess the existence, of 'Fuel Poverty', as well, in Sri Lanka.

THE JANASAVIYA PROGRAMME

The Government's lead project for Poverty Alleviation is the Janasaviya Programme (JSP) and the goals of the programmes are :-

- Helping poor families to realise their human capacities.
- Helping poor families to build-up an asset base.

Therefore, the crux of Janasaviya is access to permanent and sustainable employment. It is a people based, self-managed development process and the general approach to resource use are,

- Community managed systems
- Optimise land, water etc.
- Linkage with servicing and processing sectors (land based)
- Linkage with non-land based sectors
- Local Technology, what is cost effective, popular; eg- local fishing boats and housing.
- Need for innovation
- Must be ecologically positive

- Hamlet level restructuring

It is also stated, that "simultaneously we will harness enterprenurship and manufacturing skills to support the base, and in turn be supported by it, through setting up a country-wide a spectrum of secondary and tertiary industries" [5].

The component of JSP, which deals with the above aspect is called "Janasaviya Employment and Production Activities Programme (EPAP)" and has a five (5) tier arrangement as shown in Figure 1.

The Energy inputs are pre-requisite to make the JSP a success and sustain development. This has been recognised and the responsibility of ensuring this, has been assigned to the District Coordinating Sub-committees (DCSG).

In this context, it is also relevant to point out that the 9th schedule List 1 (Provincial Council List) of the 13th Amendment to the constitution empowers the **Provincial Councils to make statues** relating to "development, conservation and management of sites and facilities in the provinces for generation of electrical Energy (other than hydro electric power and power generated to feed the national grid)". The intentions of the provincial councils are not clear yet. Nor, are they presently equipped institutionally or resources-wise to undertake these aspects. On the other hand "Social Forestry" is placed in the concurrent list.

The roles of the Government, its various agencies, the provincial councils and the district level organisations in respect to Energy matters has to be well-defined and institutional arrangements established to facilitate planning of Energy for the rural areas.

A Brochure issued by the Ministry of Power & Energy titled "Energification - Integrated Rural Energy Development Plan" indicates the proposed Institutional Framework (figure 2) and refers to "National Energy Administration (NEA)" to be set-up under the Ministry of Power and Energy. The institutional framework

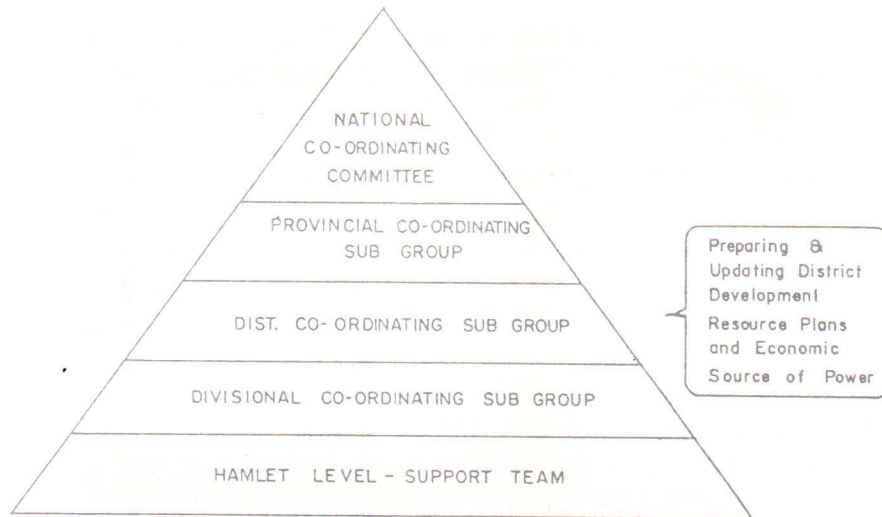
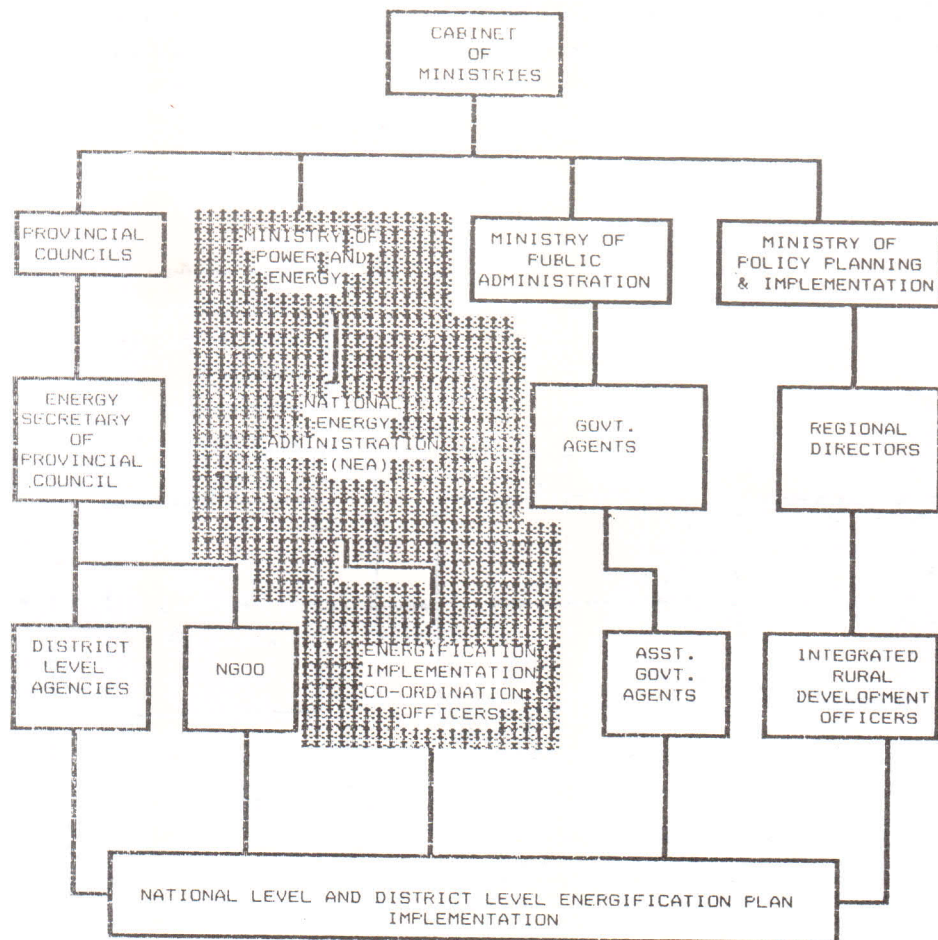


Figure 1- Institutional framework for the Janasaviya Programme



[ENERGIFICATION - INTEGRATED RURAL ENERGY DEVELOPMENT PLAN
- MINISTRY OF POWER & ENERGY - DECEMBER 1989]

Figure 2- The functional relationship and the implementation of the Energification Plan.

suggested has to be looked into in-depth to ensure that it is compatible with those of EPAP and the provincial councils.

PLANNING ENERGY FOR RURAL AREAS

The crux of planning Energy for rural area is providing as adequately as possible, the real Energy needs of the area in the forms most suited to the end uses, considering the Energy endowment of the area, the cost and the environmental impacts amongst others. This would therefore mean that the preparation of the Energy plans should have reliable data on the present Energy usage, Energy endowment of the area, together with the envisaged development activities in that area.

It is also likely that, because of the linkages with the rest of the socio-economic environment, any projects (small or large) once undertaken gets locked into the Energy system and may become difficult to reverse

(eg- plantation sector locking into petroleum products) and does not provide an easy 'second chance'. The relationship between Energy systems and the natural and socio economic environment is depicted in figure 3.

It is therefore essential that adequate thought be given to the aspect of Energy and decisions have to be based on sound data considering the linkages it has. It will also be seen that, what is required is a micro level analysis as the Energy situation and development activities will essentially be location specific. The planners should also bear in mind that Energy itself plays a very important role in bringing about socio economic changes in the rural areas. It will also be seen that Energy for rural areas cannot be planned in isolation. An integrated approach is necessary, even though it is time consuming and makes heavy demands on limited resources. Energy problems may also have to be remedied by agricultural and related development out-

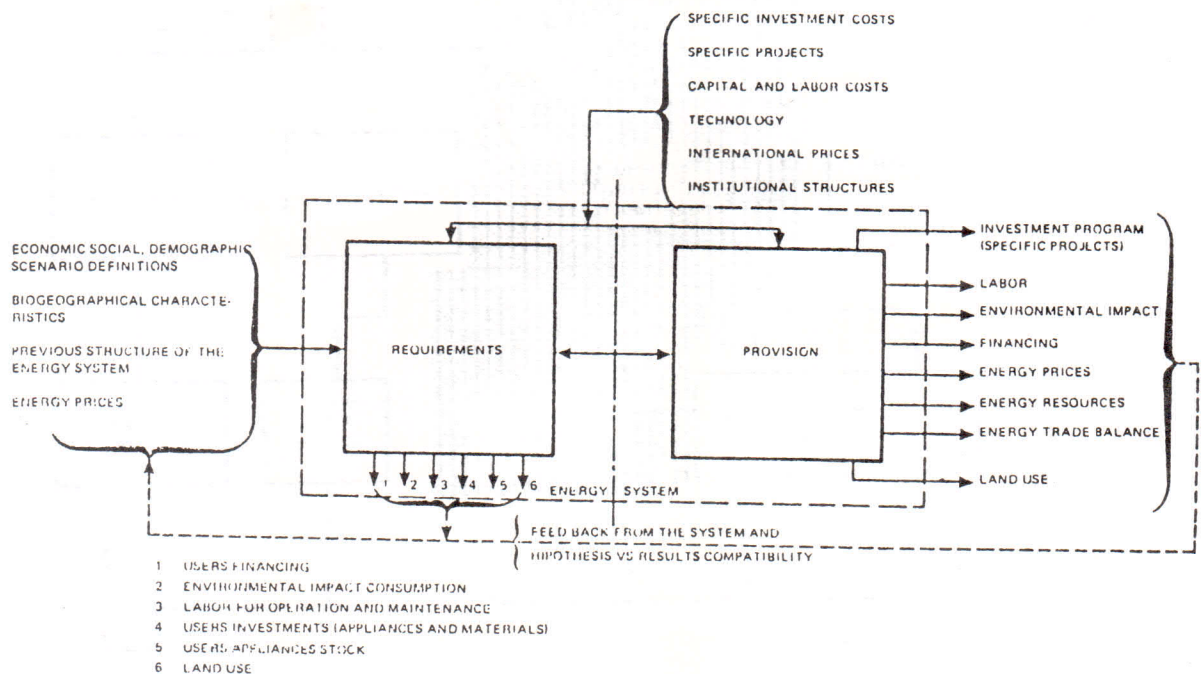


Figure 3- Relationship between the Energy system and the natural and socio-economic environment.

side the Energy Sector. Bio-mass interventions will therefore have to be integrated with the plans for other sectors, particularly agriculture.

Although it is possible to evaluate the selection of various policy alternatives, the real benefit of these would be available only if these policies are effectively implemented. This requires action at national, provincial, divisional, hamlet and household levels. At national level, the political will to implement by making available necessary resources, undertaking research and development activities, creating awareness, disseminating information are some of the important activities that have to be undertaken.

It has also been recognised that diffusion of technology and marketing are generally the bottlenecks in the process of implementing improvements to rural Energy systems. This calls for effective co-ordination of activities at provincial/district and divisional levels.

Demand for Energy

Demand for Energy will arise from :-

- (a) survival or basic needs, ie cooking, lighting, etc.
- (b) development needs, eg- motive power for industrial activities, pumping etc.

Basic Needs

With the increase in income, the demand for Energy also increases as well as there is a tendency to switch over to conventional Energy from Traditional Energy Source (TES). Figure 4 shows the change of per-capita Energy usage with household income.

Bio-fuel transition

'Biofuel Transition' ie. transition to Conventional Sources of Energy (CSE) from Traditional Sources of Energy (TES) will lead to a higher demand of kerosene/LPG or electricity depending on prices, availability and ability of the people to purchase end-user devices.

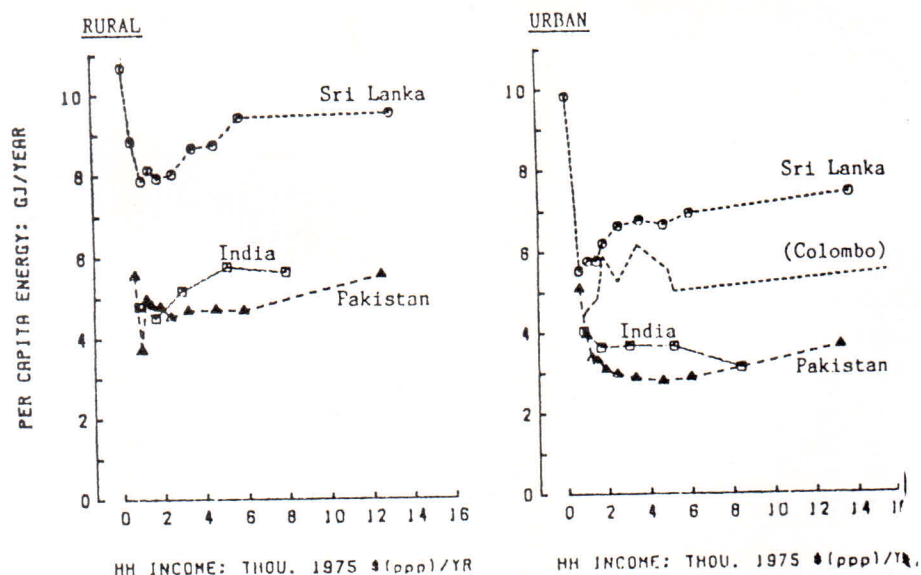


Figure 4- Relationship between household Energy use and income. (Source- Household Energy in South Asia - Gerald Leach).

TES in their natural state cannot, in most cases, be used directly for economic development purposes. It calls for new technologies to convert TES to work the equipment required for economic development. These technologies are not yet commercialised in Sri Lanka. Economic Development would therefore call for the use of conventional fuel, particularly kerosene, diesel and electricity, where available. Figure 5 illustrates this transition for Republic of Korea, which experienced rapid rural development in the 1960's.

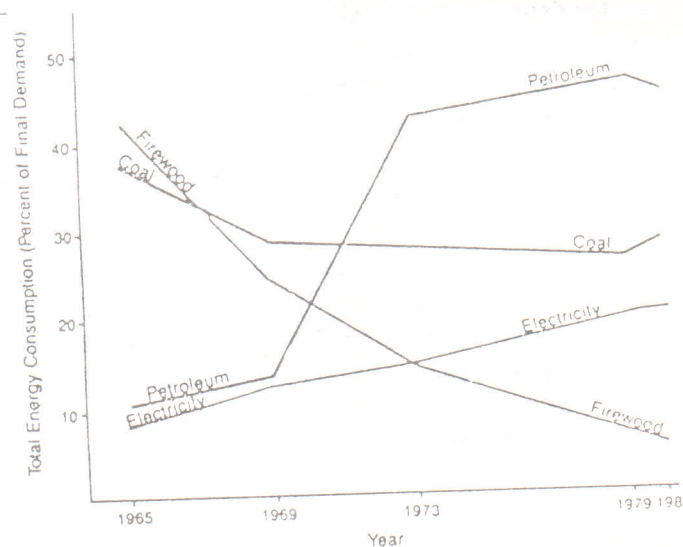


Figure 5- Post-biomass transition in the Republic of Korea.

It is obvious at in rapid development of rural areas, care has to be exercised in the selection of Energy sources, since uncontrolled usage of petroleum products either for direct use or for production of electricity will have an adverse effect on the balance of payments of the country and could use up a large chunk of export earnings for the import of petroleum products.

The continued increase in demand for TES would increase its cost, burdening the poor, who spend a greater portion of their income on Energy. On the other hand, Sri Lankan experience as far as the domestic sector is concerned is that, "even though higher income households could afford the equipment for use of kerosene, electricity or LPG for cooking, they continue to use firewood as a supplementary source of Energy for reasons of tradition and perceived taste superiority of food cooked on wood. The general pattern of rising fuel-

wood consumption with income suggests that income growth alone will not reduce pressure on bio-mass resources as often supposed" [6].

Development Activities

As 60% of the ultra 'poor' are from occupational groups where the main income earned is as labourers, fishermen, cultivators or farmers, the likely investments in income-generating assets at the end of 2 year Janasaviya Programme period will be in land, cattle, handlooms, agricultural implements, pumps etc. The manufacturing units that are likely to be set up will be lime kilns, brick & tile factories, wood-working and handicraft manufacturing units and other services, such as blacksmithy, repair shops etc.

At the end of the second year when assets are acquired, due to the present differential development of the conventional Energy distribution system and local availability of traditional sources of Energy could be further exacerbated and pockets of regions could develop "mini fuel crisis", which need to be thought of and provided for. As stated earlier, even for domestic consumption, the demand for Energy would increase. The end-result will be that there will be a 'biofuel transition', which would increase the pressure on conventional fuels or, it could increase the demand for TES itself. If these phenomena are not considered and provided for, the increased income of the households would be siphoned off by the increased fuel costs and the outputs of the envisaged local industries could become uncompetitive.

In this context, the findings of researchers of the book titled 'Energy and Development' are relevant and emphasise the need for proper orientation in planning for Energy in rural areas. They say, "A properly oriented development of Energy system may play an essential role in this process: from a provisions view point by using local resources in a more rational way and by relying on appropriate technologies: from a requirements point a view by promoting the most essential end-uses and choosing the appropriate equipment"[7]. It will be seen that this concept coincides with that of the JSP.

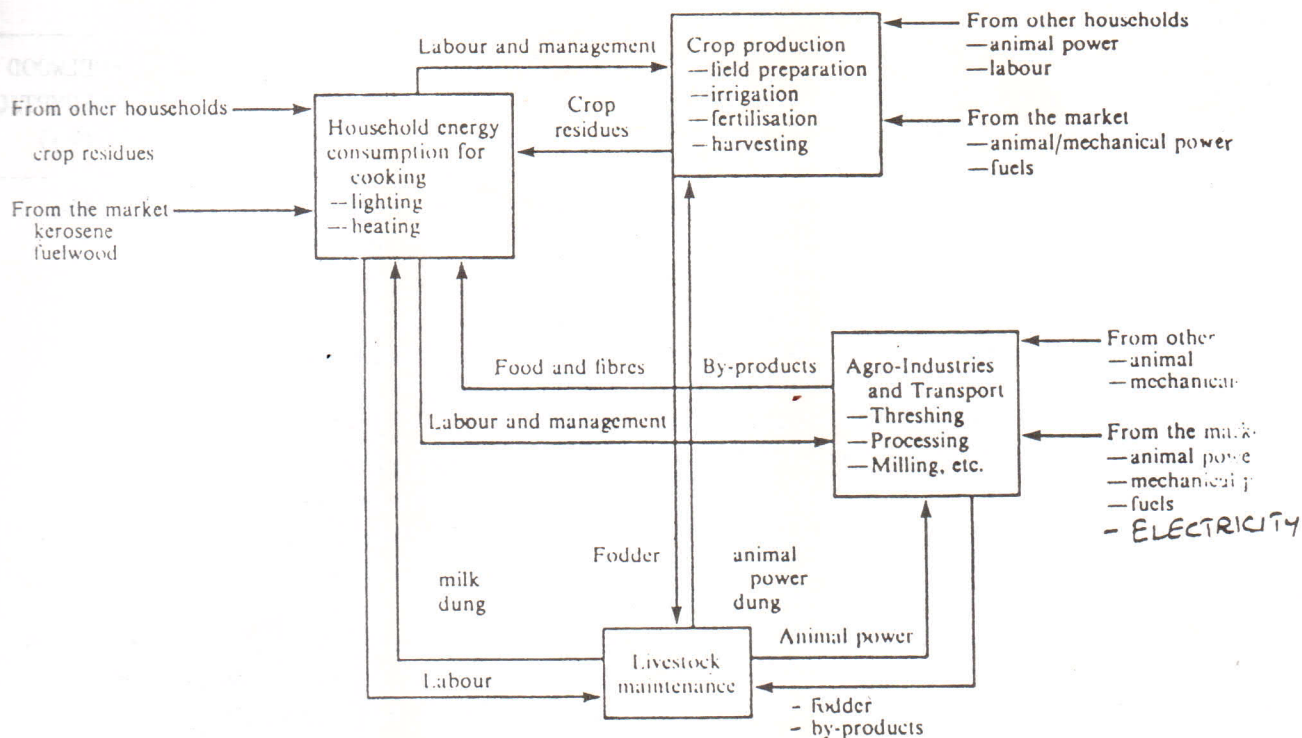


Figure 6- Energy conversion and use in rural areas

Figure 6 depicts the typical Energy conversion and use in rural areas [8].

Data collection

The need for collection of household/hamlet/village level data on Energy is therefore imperative. The data has to be not only collected diligently but also analysed in the proper perspective.

The data at hamlet level should include roads, railways, forest areas, rainfall level, irrigation facilities (or possibilities), type of soil, area under cultivation of major crops, cropping pattern, average farm size and distribution, land available for cultivation and grazing, availability of shrub land, fuelwood, per-capita income, conventional Energy source availability and distribution system availability and trained persons etc.[8]. In any event, such data is necessary to map-out the possible development activities in that area and land banks are expected to have such maps[9]. However, some more details would have to be collected to make it useful for Energy planning.

Data analysis

The data so collected, has to be analysed by multi-disciplinary teams at the district level (DCSG) to map-out the possible development activities, which would be economically feasible, socially profitable and would integrate with the general pattern of development of that region. The analysis should provide answers to the following :-

- Is there a shortage of Energy in the hamlet, if so for what purpose, eg- cooking, lightning or other activities? Are there any plans to meet this shortage?
- With the availability of added cash for consumption and for development, how are the Energy use patterns likely to change? What will be the type of fuel?
- Do the people feel that the lack of Energy acts as a constraint on their ability to utilise their resources such as lands? Have they any preference to the type of fuel?
- How much are the people prepared to spend extra on household Energy, invest in end-user devices for homes or for economic

activities? [10].

The development plans for the hamlet/district have to be analysed and the likely demand for Energy resource for the hamlet /village will have to be worked out. The possibility of integrating the Energy needs of a cluster of hamlets may have to be looked into as well as there could be economic possibilities of doing so. This has to be looked into by the District Co-ordination Sub-group. The possible demand for Energy for likely economic activities are given in tables 1 and 2.

Activity	Installed Capacity required (kW)
Carpentry Shops	05 - 15
Bakeries	02 - 05
Handicraft Activities	01 - 02
Small Saw Mills	15 - 30
Small Sugar Cane Mill	10 - 20
Grain Mill	03 - 20
Weaving	0.5 - 06
Quarries	06 - 30
Ice Making	06 - 60
Irrigation Pumps	02 -100
Brick Making	01 - 05
Lodging (20 Guests)	02 - 05
Restaurants	01 - 02
Vegetable Canning	05 - 20
Diary Products (Butter,Cheese)	02 - 10
Silos	03 - 05
Electrical & Mechanical Workshop (Repair)	05 - 15
Petrol Pumps	0.5 - 05

Table 1- Installed capacities required for productive activities in isolated areas. (Source - UNIDO "Mini Hydro Stations- A manual for decision makers" - New York 1983).

Energy Balance

When the Energy supply is matched against resources, an Energy deficit or surplus could become evident. The Energy strategies would have to be worked out thereafter. There is also the need to check Rural Energy Plans with the National Energy Plan to ensure consistency.

PRODUCT	UNIT	FUELWOOD CONSUMPTION (kg)
Tiles	1000 No.	2670
Bricks	1000 No.	500
Coconut Oil	1000 No.	300
Desiccated coconut	1000 kg	1500
Tobacco	0.4 ha	7000
Rubber	1000 kg	1000
Tea	1000 kg	3500

Table 2- Fuelwood consumption per unit of production in different industries

(Source- Biomass Fuel and its utilisation in Sri Lanka L.C.A. de S. Wijesinghe - SLEMA Journal Vol. 2 No.3 June 1989)

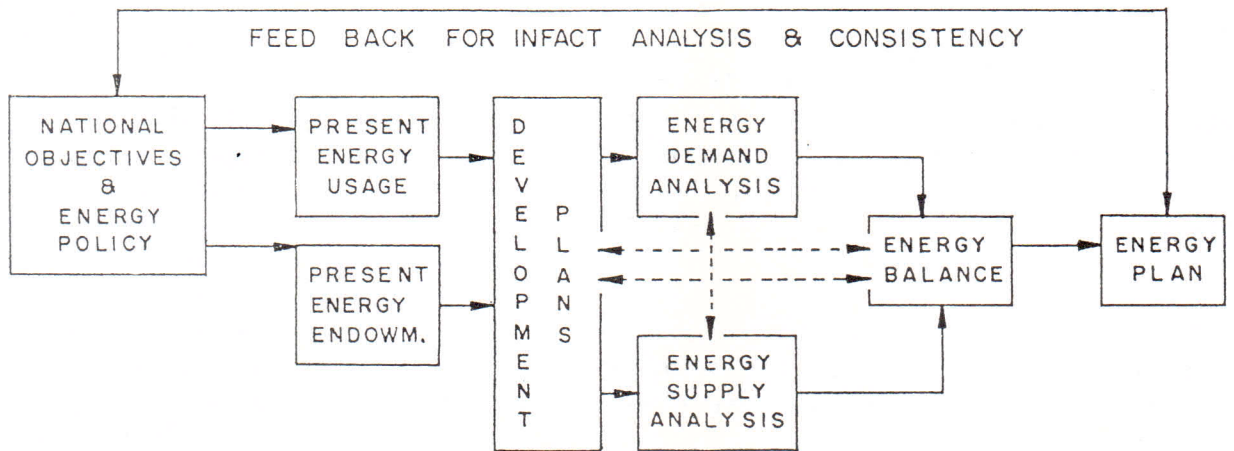
It should also be kept in mind that rationalisation of land use which is to be undertaken by the Land Reform Commission could change the present availability or otherwise of Energy resources in the area. For example, some land presently under intensive cultivation may be brought under agroforestry or vice versa.

In the event of Energy surplus the options could be,

- to replan development activities for use of more Energy or
- market it to the adjoining hamlet/village.

In the case of Energy deficit, the options could be,

- re-orient development plans to be of less Energy intensive.
- augment the existing CE capacity or distribution system or introduce new CE. eg- LPG.
- adopt vigorous Energy conservation efforts, eg- improvement of Energy end use devices.
- augment TES availability eg:- social forests, home garden plantations,
- consider use of NRSE. eg:- Bio-gas, etc.
- localized diesel electricity generation.



(Adopted - INEP in Developing Countries - Mohan Munasinghe.)

Figure 8- Integrated National Energy Planning

RURAL ELECTRIFICATION(RE) AND JSP

The extension of electricity distribution as a source of Energy for rural areas, though said to helping to,

- (a) improve quality of life,
- (b) reduce inequalities in rural population,
- (c) arrest migration to urban areas,
- (d) improve health, education and civic amenities,
- (e) increase employment opportunities in rural areas and
- (f) spread of Industries,

have to be approached with care. Studies elsewhere indicate that rural rich benefit more from RE than the poor, migration from electrified areas to urban areas are greater than non electrified areas, electrification sometimes tends to reduce rural employment and that the spread of industries has not been achieved as anticipated [11]. The situation in Sri Lanka has not been studied in depth but

one of the studies made by the CEB on rural electrification shows that

- (i) household expenditure on fuel has reduced
- (ii) the income of employees have increased about 20% and
- (iii) children study for longer time [12].

The advent of grid connected RE to the village has not made a substantial contribution to the creation of new economic activity [13].

In view of the high capital costs involved and its effects on the operation of the electric utilities, there is a need to adopt a cautious approach to rural electrification, by extension of grid supply in Sri Lanka at this juncture . There is no doubt that there will be an "outcry" for extension of the electricity facility. The planners need to satisfy themselves whether the 'out cry' is from the target group or the rural rich?

In fact, provision of electricity to rural areas could make the distinction between 'poor' and the 'rich' highly 'visible' leading to socio-conflicts.

In general, there is a threshold of income below which access to electricity is low either because income of the people is not adequate to purchase electric power or because the wealth of the country is not adequate to provide it. Beyond this threshold, the percentage of population with access to electricity increases rapidly [14].

Such phenomena could occur due to increase in income level under JSP but the wealth of the country may prove to be inadequate to meet such demands. In Sri Lanka, there is a noted shift from kerosene to expensive electricity as a source of Energy for lighting beginning at income range of Rs.800/- to Rs.1500/- p.m. [15].

Rural Electrification does not necessarily mean the extension of the grid supply to Rural Areas. This also includes localised electricity generation by diesel generating sets, wind power, photovoltaic cells etc. Indicative prices of different methods of generating electricity is given in Table 3.

The Planners should also consider the note of caution in this regard. Rural Electrification (extension of grid supply) policies and criteria for selection of areas to be electrified must be based on explicit considerations such as minimum population, load densities and potential load growth, productive use of electricity, financial economical viability and so on. The CEB should be encouraged to develop such a comprehensive set of rules to meet national objective and then stand firm against pressures to isolate these criteria [15].

Technology	Specific Generation Costs(US\$/kWh)			Remarks
	Optimistic Rs.	Expected Rs.	Pessimistic Rs.	
INCINERATOR	12.32	3.88	6.08	Reliable, proven, solves waste problem
OTEC	0.92	2.68	5.76	Base power unproven on commercial scale
PHOTOVOLTAIC	9.96	24.88	48.84	No power during peaking hours
SOLAR POND	1.84	3.08	4.68	Energy storage power can be produced during peaking hrs.
SOLAR FARM	3.68	5.40	8.20	
WIND POWER	2.4	4.48	8.44	Rather variable but proven source
WAVE POWER	1.68	3.72	6.4	May be variable on wave characteristics

Table 3- Costs of non-conventional electricity generating systems

**POSSIBLE ENERGY RESOURCES
THAT COULD BE EXPLOITED**

Biomass

Bio-mass at present accounts for 71% of the primary Energy consumed in Sri Lanka and will be a dominant factor in the Energy scene of Sri Lanka for some years to come. The present annual consumption of bio-mass fuel is about 9 million tonnes, made up of 7.9 million tonnes in the domestic sector and the balance in the industrial sector.

Biomass resources consist of wood fuel, agricultural and animal residues and these at present contribute to about 80-90% of Energy requirement of rural homes. Wood fuel include logs and other materials, obtained from forests or home gardens. Agricultural residue consists of straw, rice husks, coconut shell, etc., wood fuel obtained from forest logs, dead trees, branches, twigs, barks, etc., or by-products of logging operations. Obviously, availability of Energy resource depends on the extent of forest or shrub land, agricultural activities and the extent of homestead wood lots. Generally, agricultural residues contribute about 90% of the gross total bio-mass consumption.

The availability of agricultural residue to serve as Energy resource depends on the "eco-agricultural and socio-economic system and has competing demands, Eg. straw can be used as a source of Energy, food for cattle, material for paper production or as fertilizer. The selected use of the residue will depend on the particular needs of the farmer. For example, the recent removal of the fertilizer subsidy could result in the farmers using more agricultural residue as a fertilizer than as a source of Energy. However, fuelwood supply can be increased by growing selected fast growing trees in social forests or in home-steads but is limited by the availability of suitable lands, while availability of agricultural residue will depend on intensity of land use and extent of land. In Bangladesh "it was found that introduction of high-yield grains led to bio-fuel shortage due to the lower residue/grain ratios of the miracle varieties. Clearly, both food and fuel

need should be considered when bio-mass innovations are planned". [17]. The intensification of land use would call for irrigation, which again calls for additional demand for Energy.

In general, it look as if there could be a scarcity of fuelwood in some areas of Sri Lanka but taking the country as whole, there is no deficit of fuelwood until the year 2000. However, pockets of areas will face minor fuel crises. Eg. "Firewood scarcity hits brick industry" screams the headlines. "The brick industry in Hambantota District had been badly hit by a firewood scarcity in the area. Many families who depend on this industry for a source of income are now helpless." [18].

Land use will be based on the policy and guidelines laid down by the National Land Commission. Rational land use will lead to re-forestation of some land which is now under intensive cultivation. The re-forestation programme for the years 1989 to 1993 is given in table 4.

Area	Thousands of hectares
Neglected Tea & Rubber land	169
Sinharage M & B Reserve	200
Community Forestry	2700
Integrated Rural Development	300
Reforestation and Development	500
Forest Sector Development	20,000
Total	23,860

Table 4- Re-forestation Programme 1989 - 1993
(Source- Public Investment 1989 to 1993)

The demand for fuelwood could also be reduced by improving the efficiency of its usage as done under the National Fuelwood Conservation Programme, where the efficient wood burning stoves are introduced in the rural and urban areas. The estimated efficiency improvement is 25% [19].

The direct employment potential is low except in the case of 'Energy forest' for

generation of power which will be dealt later. The collection of fuelwood in rural areas is not considered an economic activity as it is not generally done on a commercial basis. However, in India as a whole, it is estimated by the centre for science and environment in New Delhi (1985), as many as 1 million people make their living solely by taking head loads and cart loads of wood from rural areas to cities. In Sri Lanka, too, a section of the population is engaged in collection, transportation and processing of fuelwood for commercial purpose, but their number is not known.

Use of biomass for industrial processes for obtaining low quality heat, eg. for raising of steam, will continue and has to be considered.

Dendro Power

During the period 1987-88, a total of 72,000 ha of land was reforested and approximately 27,000 ha of forests are to be established within the next 3 years. The existence of large extents of land for re-forestation could make it possible to establish Dendro Power Plants to provide localised electricity supply to isolated places. A typical dendro thermal plant will require a tree farm, a wood-fired plant and a transport system. It is estimated that a tree farm of 500 ha will be required to sustain a 1000 kW plant (ie half a ha/kW).

The transformer capacity of rural electricity schemes vary from 50-250 kVA with an average of 120 KVA. A hamlet is set to consist of 150 families and about 60 ha of forest is required to sustain a 120 KVA plant. The other factors that need to be considered are that the land should be contiguous with suitable soil condition with an annual rainfall ranging from 400mm to 2000mm and there should be ample supply of water to support plantation and the power plant requirements.

The advantages in resorting to dendro power on a de-centralised basis are its assistance to greater employment creation, increase in income of the people in the hamlets and availability of electric power to stimulate economic development of the area. The total

cost for providing electricity to isolated areas will be relatively less.

Bio-Gas

Bio-gas technology is well developed and could be used for providing a source of Energy for heating and lighting and is being commercialised. Introduction of this technology to the rural areas also depends on the availability of input materials, and socio-economic and cultural factors. Indian experience suggests that only the 'better off' state of the population has the means to operate bio-gas plants on a family basis. On the other hand, Chinese have probably the largest number of family unit bio-gas plants. Their success is attributed to the existence of a strong tradition of collection and fermentation of organic waste (specially night soil) for use as fertilizer.

Community based bio-gas plants are yet to be commercialised in Sri Lanka. The employment potential is once again not so high, as the construction of a bio-gas plant calls for 13 to 375 man days depending on the size of the plant. Staff required to operate a larger plant is one or two at most. If the plant is to have an engine, an additional mechanic will be required. The services of labourers for collection of dung and delivery of slurry will also be required [20]. Experience elsewhere suggests that community based bio-gas plants are relatively costly and attempts to establish such plants have often been unsuccessful because of organisational and institutional shortcomings and conflict of interest of its usage. eg:- should it be used for lighting, heating or operating pumps. These of course are not insurmountable.

Micro/Mini Hydro Plants (up to 1,000 kW)

Development of hydro-power, even on a smaller scale requires multi disciplinary work and skill, and involves manpower skilled in civil, mechanical and electrical Engineering, hydrology, hydraulics etc. It also calls for site surveys, feasibility studies and detailed engineering design.

The Masterplan for the Electricity Supply of Sri Lanka states "there are many good possibilities for the development of small-scale hydro projects and 11 such projects are included in the Master Plan. It is recommended that CEB undertakes a nationwide Masterplan study for small scale hydropower development."

"The cost of electricity generation by small scale hydro power stations depends on a number of factors, such as the nature of site, type of installation, sources of equipment and material supply, availability of manpower for construction as well as operation and maintenance, utilisation of plant, sources and terms of finance etc." [21]. Economic operation of the plant calls for high load factor operation and has therefore be implemented in conjunction with a number of power consuming industries".

The other option would be to directly use the mechanical power from turbine for driving other machinery, Eg. earlier tea estates. The employment potential is high during the construction stages, but the labour has to be provided free to make the scheme economically viable.

The capital cost of a plant varies between US\$1000 - 5000 depending on size of plant and the total cost will be site specific.

Wind Energy

Wind Energy has been used for centuries for water pumping and milling of grain. Tawary(1978) and Buch(1979), reported that in India and Sri Lanka, even in marginal wind regions (around 3 m/s) water pumping with wind mill is cheaper than use of diesel or even bullock power. In most cases it is also cheaper than grid-connected power, if the real costs of rural electricity are taken into account. The economics depends of various factors, such as crop to be watered, season during which water is required, the technology used for the manufacturer of the wind mill.

Wind mill can also be used for electricity generation, the capital cost however varies from US\$1000 to 10,000 per kW. The cost is site dependent.

The choice should also fit into the overall energification Rural Energy Plan of the Ministry of Power and Energy.

Private Sector Participation in Energification

Energy projects, particularly the newer technologies are costly and capital requirements are high. The possibility of getting private sector participation in the Energification projects would assist in a long way.

The possible areas are :-

- (i) Social forests and power generation
- (ii) Setting-up diesel generating sets.
- (iii) Large bio-gas plants for generation of
- (iv) Co-generation (where steam is required for processing)
- (v) Setting up photovoltaic battery charging stations and
- (vi) Wind generator farms

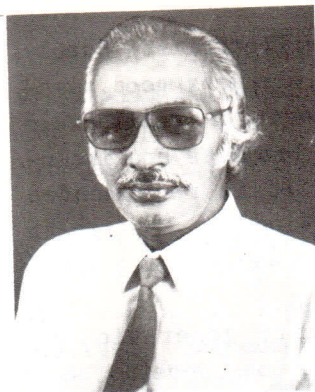
These activities involve high capital and the government has to provide incentives for such ventures (Eg. tax holidays, duty free imports of equipment etc.) and a guarantee to buy power from them at guaranteed prices over long periods and buy back the capital equipment at an agreed price when electricity distribution is extended to these areas.

In a smaller scale, the village level industries that use motive power, (eg. fibre mills) can be encouraged to use the engines to generate power at night and sell it to the dwellings close by.

REFERENCES

- [1] Sunimal Fernando and Wille Gamage, Economic Review, July/August, 1989.
- [2] Asian Development Bank Annual Report for 1988.
- [3] and [17] Kirk Smith, Pacific Asian Journal of Electricity, January 1987.
- [4], [6] and [15] Priyantha Fernando - Changes in Demand for Energy in the house hold sector service 1974 - SLEMA Journal.

- [5] Sunil Siriwardena. - Christian Worker 2nd October, 1989.
- [7] Energy & Development - What challenges ? which methods - The commission of the European Communities 1984.
- [8] and [10] Romesh Bhatia - Energy and Rural Development - An analytical frame work for socio-economic Technological Policy Alternatives.
- [9] Ministry Circular 02/228 dated 03.03.1989 Ministry of Lands, Irrigation and Mahaweli Development.
- [11] and [20] Integrated Energy Planning - Vol. II, ADPC, 1985.
- [13] G.T. Fernando and Sujeewa Rajapakse, Costs, benefits and Economic viability of RE - Sri Lankan Experience.
- [14] Electric Utilities Data Book for the Asian Pacific Region, 1988.
- [16] and [17] Mohan Munasinghe, Integrated National Energy Planning and Management, W.B. Technical Paper No.36 1984.
- [18] Ceylon Daily News, 9th February, 1989.
- [19] Manpower Profile in Energy Sector, Bio-gas UNDP/.ILO, 1984.



Mr. K. Sivasubramaniam (Siva) joined the Department of Government Electrical Undertakings (DGEU) in 1952 as an apprentice and has served in various positions in the DGEU and subsequently in the Ceylon Electricity Board (CEB). He presently serves as a Manager (Systems and Organisation Development). Mr. Sivasubramaniam was involved in the Energy Conservation Campaigns of the CEB and has followed the "Management of Energy Resources and Energy Saving" course at the International Training Centre for Advanced Technical and Vocational Training - Turin, Italy and "Energy Conservation Training Programme at Tennessee Valley Authority - USA.

Mr. Sivasubramaniam is a Corporate Member of SLEMA and was the first Editor of the SLEMA Journal.

SLEMA NEWS AND FUTURE EVENTS

NEWS

- * The Members' Evening was held on 11th October at SLAAS premises. about 20 members participated in this informal gathering. The evening began with a presentation on Water Quality, Energy and the Environment by Mr E M Piyasena (Member). A lively discussion followed the presentation.
- * The Members' Day was held on 21st October at Beruwala. Forty five members, their families and guests joined this outing.
- * Seminar on Energy Conservation in Compressed Air Systems was held on 8th November (organised jointly with Swedish Trading Co. Ltd). Over 110 participants, including SLEMA members who accepted the free opportunity to join, participated in the seminar. Those who followed it will know how valuable it was !!!.
- * Training Course on Steam Generation and Distribution commenced on 24th November. This course for 25 Boiler operators and Technicians will continue for 6 consecutive Saturdays.

CONTD....