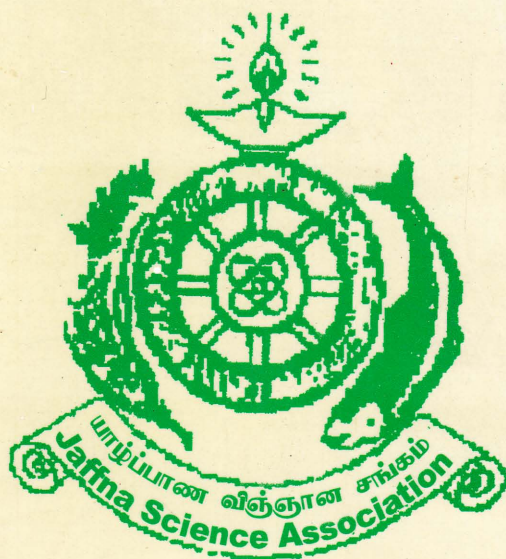


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PROCEEDINGS OF JAFFNA SCIENCE ASSOCIATION 2003

Volume: 11

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ELEVENTH ANNUAL SESSIONS
HELD ON
APRIL 02,03& 04TH 2003

UNIVERSITY OF JAFFNA
JAFFNA
SRI LANKA
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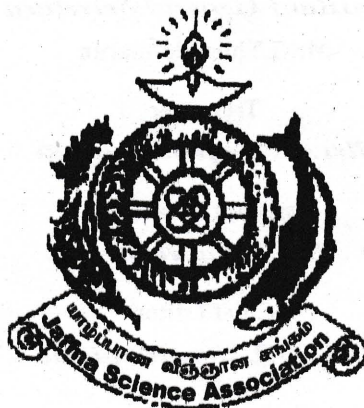
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PROCEEDINGS OF JAFFNA SCIENCE ASSOCIATION 2003

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**PRESIDENTIAL ADDRESS
CHAIRPERSON'S ADDRESSES
REVIEW LECTURES
THEME SEMINAR
POPULAR LECTURE**



**ELEVENTH ANNUAL SESSIONS
HELD ON
APRIL 02,03& 04TH 2003**

**UNIVERSITY OF JAFFNA
JAFFNA
SRI LANKA
2004**

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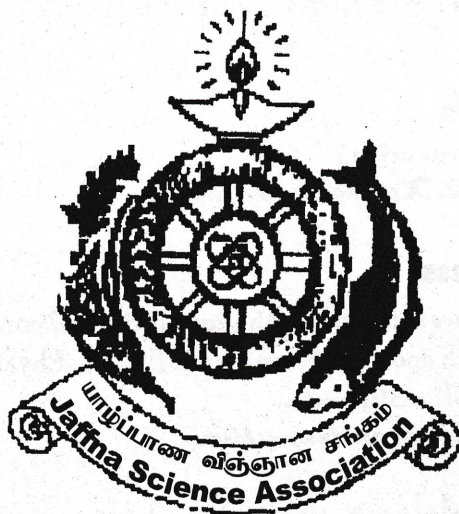
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This volume is a record of the proceedings of the Eleventh annual sessions of the Jaffna Science Association. This contains the Presidential Address, Addresses of the Chairperson's of sections A and B paper presented in the Theme Seminar, Review Lectures and a Popular Lecture, which were delivered at the Annual Sessions of the Association held at the University of Jaffna from 02-04 April 2003.

I wish to thank the President Prof.R.Kumaravadivel, General Secretary Dr.Srisatkunarajah, Editors of Sections A and B and Dr.(Mrs).Sivamathy Sivachandran of the JSA for their support.

I also wish to extend my sincere thanks to the authors, for their kind assistance.

Prof.R.Sivachandran
Chief Editor

Department of Geography
University of Jaffna,
Jaffna, Sri Lanka,
April 21st 2004.

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The Sri Lankan Energy Crisis



*Prof. R. Kumaravadivel,
Dean, Faculty of Science,
University of Jaffna.*

*President,
Jaffna Science Association,
2003-2004.*

I wish to express my deep appreciation of the honour the Jaffna Science Association has bestowed on me by electing me as its President for this year. I am conscious of the responsibility the Association has placed in me and my colleagues in the new Executive Committee. With the willing cooperation of the Executive Committee - the General Secretary, Assistant Secretary, the Treasurer and the Editor - I hope to carry through a programme of work successfully during the forthcoming year.

I have chosen to speak on 'The Energy Crisis in Sri Lanka' because, to my mind, this is one of the most important subjects that has engaged the minds of the intellectuals in this country next to the North East war and the ongoing peace process.

1. Introduction:

Energy has played a key role in bringing about social transformations through the ages. Today, energy is at the heart of contemporary living and is at present the biggest concern of mankind. We need energy for growing, processing

and cooking food, in the production of clothing, for industrial applications, in transport and entertainment etc. Life as such has become impossible without energy. In fact, the material prosperity of a society is determined to a large extent by its per capita energy consumption. There is a close correlation between the per capita consumption of energy and the Gross Domestic Product (GDP), and a comparison of the GDP growth rate and the growth rate of energy demand shows that one follows the other closely. Therefore as we strive to lift ourselves up economically, the energy consumption will rise.

Energy is available naturally in many forms:

(a) animate energy : energy of muscular action of men and animals (derived from food they eat).

(b) inanimate energy : falling under four major categories

(A) Chemical energy derived from chemical reactions as in

- (i) gunpowder
- (ii) animal and human waste (Biogas)

(B) Thermal Energy derived from

- (i) burning fossil fuels like coal, oil and natural gas
- (ii) Sunlight (solar energy)
- (iii) Biomass / Dendro

- (iv) geothermal energy
- (v) the thermal gradient of the ocean (Ocean thermal energy)

(C) Mechanical Energy derived from

- (i) water falls (hydro power)
- (ii) Ocean waves (tidal or sea wave energy)
- (iii) Moving air masses (wind energy)

(D) Nuclear Energy - the enormous energy released in

- (i) the fission of atoms/nuclei.
- (ii) fusion of nuclei (not yet available for practical use)

The marvellous civilizations of India, Egypt, Babylon and Rome were all founded utilising animate energy. Estimates show that the energy output of human labour cannot exceed 100 kw-hours per year per person.

Although the use of solar energy, energy of flowing water and the energy of the sea waves have been in use from time immemorial, the planned harnessing of various forms of inanimate energy gained momentum only around the 15th century. As a result, trade, commerce and craft techniques began to flourish rapidly. The firearms, based on inanimate energy of gunpowder, helped its inventors - the Europeans - to colonize the world. The Scientific and Industrial Revolutions of the 17th and 18th centuries paved the way

for the exploitation of energy from coal, a fossil fuel. The extraordinary growth in the supply of energy from coal stimulated economic growth which in turn stimulated education and scientific research leading to, among other technical advances, the discovery of valuable energy sources such as natural gas, petroleum and fissionable nuclear materials and the technology of producing a new form of energy called the **electrical energy** from the various sources of inanimate energy.

The increase in population and the high expectation of people for a better life both increase the energy demand. Energy analysts predict that the world's energy appetite will treble during the next 50 years. This enormous growth will take place in the newly emerging industrial countries and the developing countries.

Although energy available in the four different forms listed above could be converted from one form into another and into electrical energy, from the point of view of applications, the energy available in two forms are the most useful ones: ie.

Electrical Energy
and Thermal Energy.

Even between these two forms, from an engineering point of view, we

may say that energy available in the form of electricity is much more useful than thermal energy because of its easy transportability.

Ensuring the availability of appropriate energy sources and the generating capacity of electrical energy to meet the growing demand is essential for the economic development of any country. Therefore the task before any nation is to ensure the uninterrupted supply of these two forms of energy to match the many different needs. In practice, the government of any country needs to import or produce and market energy for three different purposes :

- (a) **Electricity** - for illumination, for industrial motive power and in electronic applications.
- (b) **Fuel for generating thermal energy** - A fuel that could be used to generate industrial and domestic thermal energy. This could be
 - (i) liquid fuel like oil, petrol, diesel, kerosene etc or
 - (ii) gaseous fuel like LPG or
 - (iii) solid fuel like coal and firewood
- (c) **Fuel for transport purposes** This could be
 - (i) liquid fuel like oil, petrol and diesel
 - (ii) gaseous fuel like LPG or compressed methane
(not used in Sri Lanka)

Of the fuel needed for industrial and domestic thermal energy, only firewood is locally available in Sri Lanka. All others - the petroleum products - will have to be imported. All the fuel for transport purposes also will have to be imported.

Electricity is somewhat different from others. It has to be generated by

converting energy in any of the four forms of energy mentioned above, namely Chemical, Mechanical, Thermal and Nuclear.

To meet our energy needs, we have been utilizing specific energy resources. These traditional sources of energy, called the 'Conventional Energy Sources' are listed in Table I.

Table I: Conventional and Alternate Energy Sources:

Application	Conventional Energy Sources	Alternate Energy Sources
Grid Electricity	Major Hydro, Oil, Coal	Mini Hydro, Wind, Dendro & Waste (Steam and Gasifier-IC Engine, Stirling Engine), Wave, OTEC, Solar Pond, Solar Chimney, Bio-Oil
Off-Grid Electricity	Diesel	Mini Hydro, Solar PV, Dendro (Gasifier-IC Engine, Stirling Engine, Methanol-Fuel Cell), Biogas (IC Engine, Stirling Engine, Fuel Cell), Wind
Industrial Heat	Fuel wood (Direct Firing), Fuel Oil, Diesel, LPG, Kerosene, Electricity	Fuel wood (Gasification), Solar Thermal, Combined Heat & Power
Household Cooking	Traditional/ Improved Wood Stove, LPG, Electricity, Kerosene	Turbo Wood Stove, Biogas, Solar Thermal, Waste, Methanol
Household Lighting	Kerosene, Electricity	Off-Grid Electricity, Biogas, Bio-Oil, Bio-Diesel
Transport	Diesel, Petrol	Bio-Diesel, Bio-Ethanol, Bio- Methanol, Compressed Bio-Methane, Wind (Sail), Electric Vehicles
Agricultural	Diesel, Kerosene, Grid Electricity	Bio-Diesel, Bio-Ethanol, Bio-Methanol, Compressed Bio-Methane, Biomass Gasifier-Engine

Except the firewood (used for direct firing) and hydropower, all other conventional sources of energy (coal, petroleum products and natural gases) are imported.

It is a well known fact that eight countries of the world own 81% of all world crude oil reserves, six countries have 70% of all natural gas reserves and eight countries have 89% of all coal reserves.

Following the middle-east war in 1973, the OPEC was formed and there was a big hike in the price of crude oil (from 3 US \$ to 11 US \$ per barrel). Since the oil crisis of 1973, the price of petroleum products are on the increase. In 1990 Iraq invaded Kuwait because of its oil wealth. Even the current military action by American-led combined forces against Iraq is said to be motivated by the desire to control the enormous oil wealth of that country.

More than half of Asia, Africa and Latin America import over half of their commercial energy. Most of these countries, like Sri Lanka, earn their foreign exchange by exporting agricultural and commercial crops, which fetch low prices. The consequence

is a drain on foreign exchange earnings. Even the rich nations themselves are not immune to confrontations on issues relating to power and energy, although they do not feel the brunt of any problems strongly for their standard of living is high and a few dollars more on the electricity bill hardly makes any impact.

Many believe that at the rate we are consuming the fossil resources, the reserves of these resources would not last very long. Due to these limitations high priority is given by policy-makers, scientists and technologists to the question of utilising new sources of energy to meet the national needs. The new sources of energy are called the "Alternative Energy Resources". These forms of energy have also been listed in Table I.

2. The Sri Lankan Scenario:

Asia, despite containing a sizable portion of the world population, is one of relatively low primary energy using regions per capita. Whereas North America uses 7.5 tons of oil equivalents per capita every year, the figure for Asia is a low 0.3 per capita. Within Asia, Sri Lanka is a distant 8th behind Singapore, Thailand, India, China, Philippines, Indonesia and Vietnam.

Sri Lanka is not blessed with any fossil fuel (petroleum and coal). However it has a reasonable amount of water resources, and electricity is generated mainly from hydropower. Imported petroleum is used to generate electricity from thermal- power plants to meet any small deficiencies. All the fuel needed for transport is imported. By the year 1989, much of the major hydro-power potential had been harnessed.

2.1 Present Electricity

Generating Centres:

The following is a list of the present electricity generating centres:

Hydro Power Stations:

Lakshapana complex 335 MW

Maussakele

Castlereigh

Kaniyan

Norton

Lakshapana

Mahaweli Project 660 MW

Ukuwela

Bowathanna

Kotmale

Victoria

Randenigala

Rantembe

Samanalawewa 120 MW

Small Hydro Plants 20 MW

Total (Hydro Power) 1135 MW

Thermal Energy Resources:

Sapugasantha Diesel

Generator 152 MW

Kelanitissa 115 MW

Private / small thermal
generators 75 MW

342 MW

Natural Gas Turbines:

Kelanitissa 120 MW

120 MW

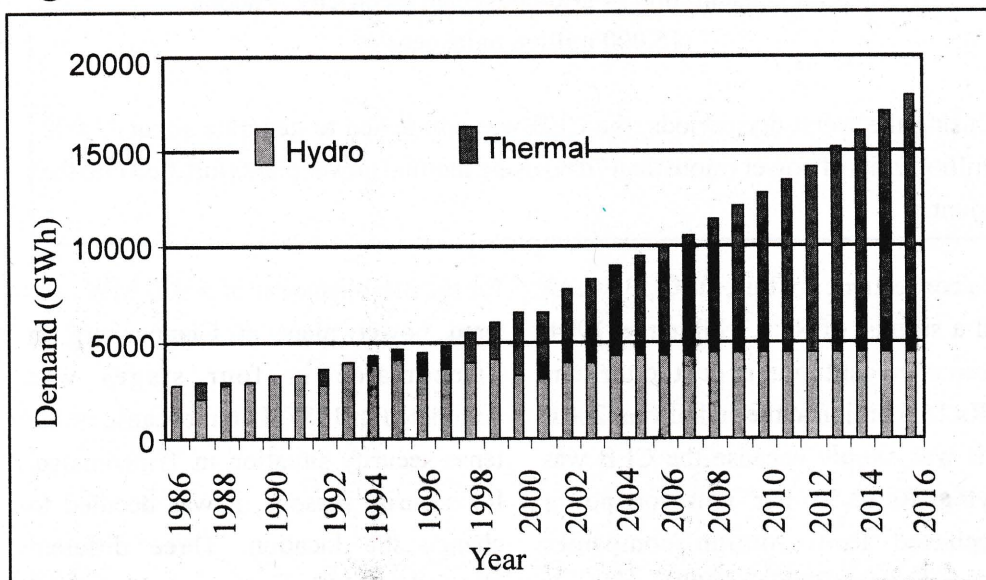
Grand Total 1597 MW

Note 1 : Kelanitissa thermal power generator (115 MW) began operation in May 2002

Note 2: It has become clear now that the last available source of hydropower is to be utilised in the upper Kotmale region.

If all the above hydropower stations could work to full capacity, we would yet face power cuts. However due to drought and other factors, we have been compelled to generate more and more electricity from thermal generators since 1995. Fig I illustrates the grid- connected electricity demand in the past and the projected demand in the future.

Figure I: Grid- connected electricity demand (annual)



2.2. The Power crisis of year 2001/2:

It would be interesting to know the reasons for the severe power crises faced by the country in 2001/2 when five hours of power cuts were imposed. In 1977 the installed power capacity was 400 MW. Between 1977 and 1994 about 800 MW were added to the national grid from Mahaweli and other hydro projects. In 1994, the total demand was 848 MW and the total power that could be generated stood at 1359 MW (A surplus of 511 MW). In Dec. 2001, the total demand was 1400 MW but the total power that could be generated stood at 12MW (Scarcity of 200 MW) The dwindling of power supply in year 2001

was attributed to the following:

- (a) Failure of the government in power during the period 1994-2001 to commission the Kukuleganga & Kotmale hydro projects and the Kerawalapitiya Thermal Power project in time:
- (b) Severe drought.
- (c) Sri Lanka's power generation did not receive any appreciable capacity building through renewable energy sources.
- (d) Absence of proper planning.
- (e) Aging power plants were not given proper attention (poor management).

Our consumption of grid-connected electricity is about
15,000 million units per day

During the worst dry periods, the CEB was compelled to generate about 11,000 million units of power (more than 70%) using thermal power plants airlifted into the country

As a consequence of this, the CEB, which had a surplus of Rs.5.7 billion in 1994, became an institution in debt to the tune of Rs.16.5 billion at the end of year 2001. This was simply because the CEB was paying Rs.12.50 per unit for power purchased from foreign companies during the years 2000 and 2001.

2.3. The CEB solution Coal fired power plants:

It appears that since the early 1980s the CEB had been warning the Government of an impending power crisis, and the imperative need to find ways and means of adding more power to the national grid. The demand for electricity for household and industry was increasing annually by leaps and bounds, but the rainfall pattern was extremely erratic and providing power only through hydro-generation was becoming well nigh impossible. The idea of having a coal-fired power plant was mooted at that stage. Trincomalee was chosen as the most suitable location. A feasibility study

for the establishment of a 900 MW coal fired power plant at Clappenberg in Trincomalee in four stages was completed in 1987. Later, because of the tense security situation in Trincomalee, for security reasons, it was decided to change the location. Three different alternative locations were considered and Noraicholai was the choice of many and large sums of money were spent on feasibility studies. However due to various reasons - social, political and religious - the plan to commence building this coal-fired power plant has been stalled for the past fifteen years or so. Endless debate goes on in the press over the power crisis and who was right and who was wrong.

2.4. Stop-gap suggestions to solve the crisis:

Several 'sector-based solutions' have been put forward for the efficient management of conventional energy sources:

When daily demand is analysed, it has been found that the peak period is between 5 p.m. and 11 p.m. The CEB has suggested that separate mechanisms be put in place to meet this demand with a corresponding pricing structure. This would, it is argued, allow specific systems to be employed for specific time segments, making for a more efficient management of energy resources.

Another "sector-based" answer to the emerging energy crisis is to deploy energy produced subsequent to the expending of foreign exchange to industries that will recover these monies through exports.

However it would seem that these proposals are more stopgap attempts to deal with the problem rather than sustainable options.

3.The Real Picture of the Energy Situation:

Neither the debates nor these stop-gap attempts could solve the problem. Bold decisions are needed. What these decisions should be cannot be thought out overnight. First we must understand the problems. We should be aware of :

- (a) the present power requirements of the country.
- (b) the power requirements of the next twenty five years
- (c) the annual incremental increases for the next twenty five years
- (d) the maximum hydropower available in the country now
- (e) the maximum hydropower that would be available in year 2028(Twenty five years from now)
- (f) the concentration of consumer points
- (g) the viability of distributing grid electricity to remote regions
- (h) the cost of electricity generation from different sources(conventional and alternative)
- (i) the foreign exchange needed to import energy sources.
- (j) the issues that are specific to various sectors such as Food & Agriculture, Health, Trade & Industry, Communication, Transport, Waste Management and Water.

3.1. The Severity of the crisis:

Fig-I clearly illustrates the pattern of hydro-electric power generation in Sri Lanka during the past decade-and-a half, with likely future needs of the country being met through thermal-generation systems.

The dramatic escalation in the rate of exchange - SL Rupees per US Dollar- is illustrated in Fig II. Over this period the rate of exchange rose from less than Rs.20 per Dollar in 1980 to nearly Rs.100 per Dollar today. There

is every expectation that the rate of escalation will be even more steep in future years, with corresponding serious aggravation of our inability to pay for fossil-fuel-based thermal generation of electricity.

Fig II: Exchange Rate : Rupee Value of US \$

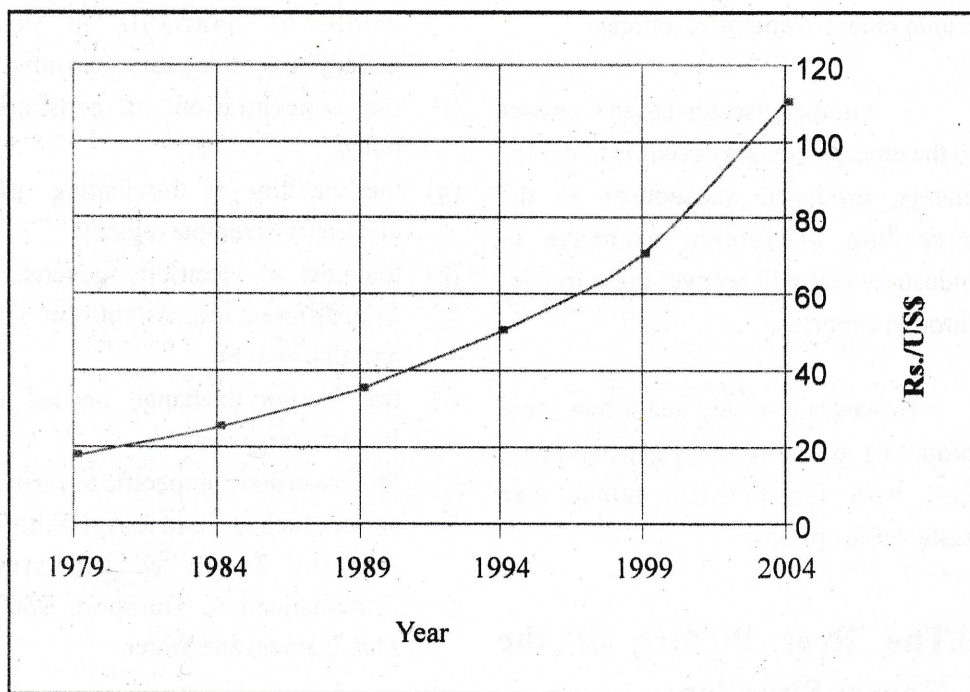
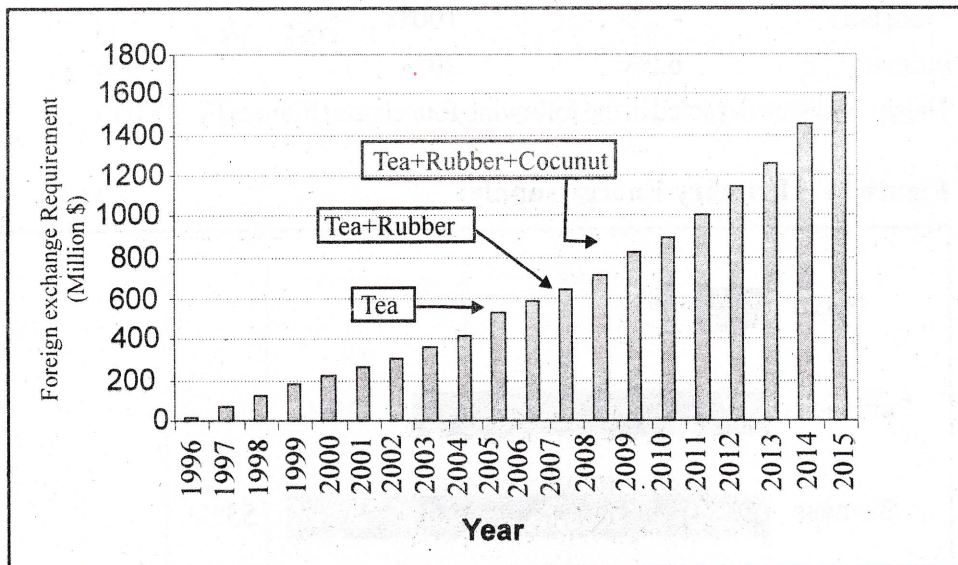


Fig III shows the foreign-exchange requirements each year for coal or oil based thermal generation.

It is observed that within about ten years, the (foreign exchange) cost for such generation will absorb all of Sri

Lanka's net foreign-exchange earnings from its major export of tea, rubber and coconut, leaving very little for other vital imports such as for food and transportation.

Fig III: Foreign Exchange Requirement per year



3.2. The energy situation in different perspectives:

3.2.1. National Energy Utilization:

The total annual energy consumption in the year 2000 was 8353 million tonnes of oil equivalent. Of this,

Biomass energy accounted for 53%,
Imported Petroleum for 39%,
and Hydropower for the balance 8%.

Among the sectors, the household sector consumed 51 %, transport 26% and industry 23 %

Within the sectors, the distribution is as follows:

Sector	Biomass	Imported Petroleum	Electricity
Household	84%	9%	7%
Transport	-	100%	-
Industry	62%	29%	9%

These values are depicted in the following four charts (Figures IV - VII):

Figure IV : Primary Energy supply:

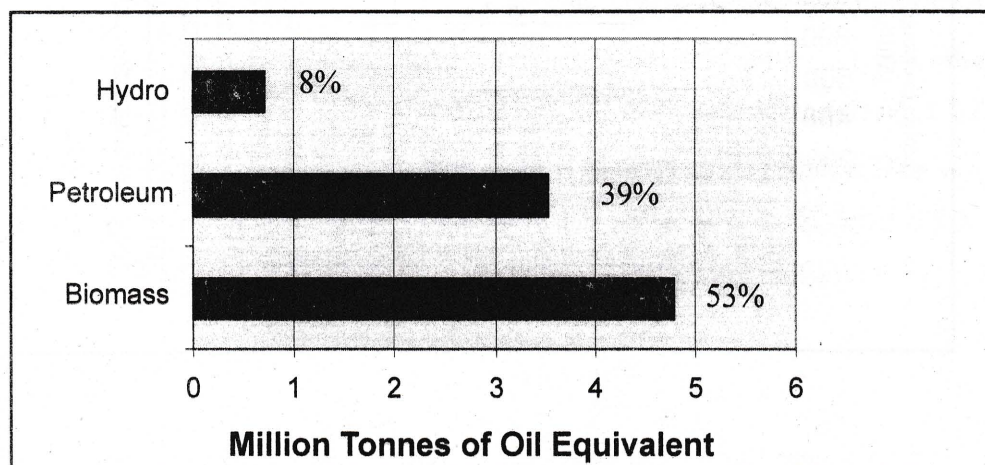


Figure V: Energy Consumption by Sectors:

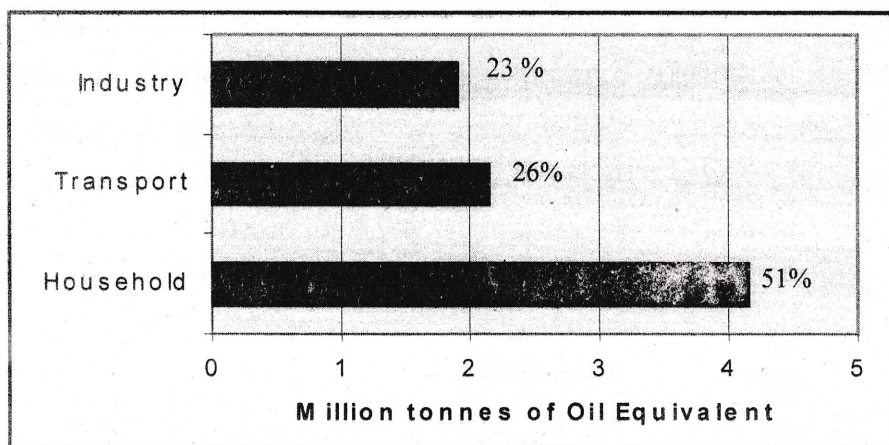


Figure VI: Energy Consumption in Household Sector:

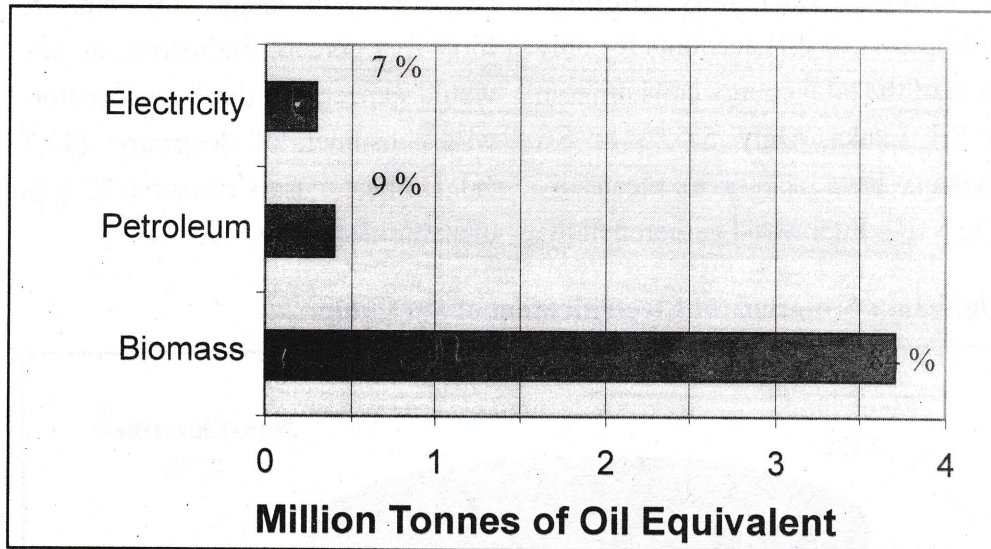
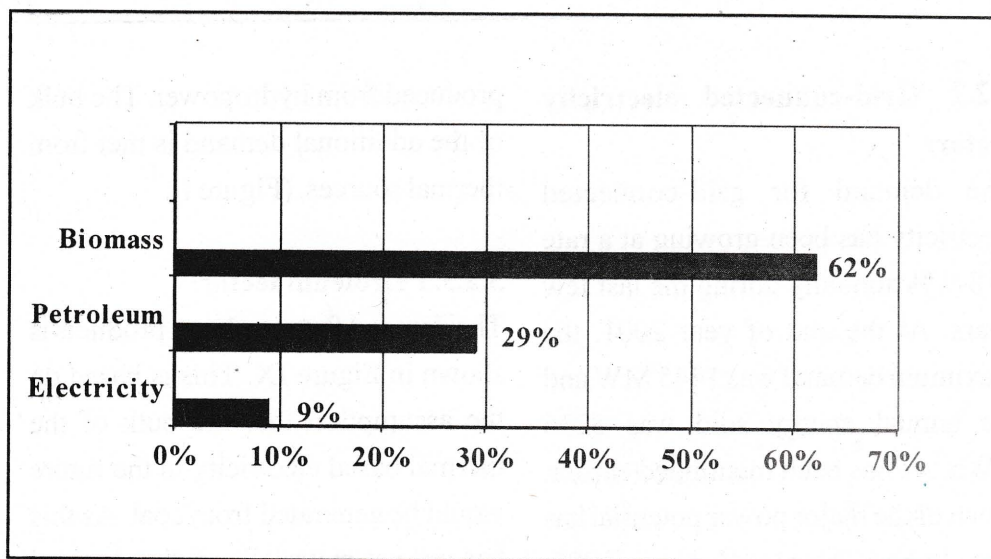


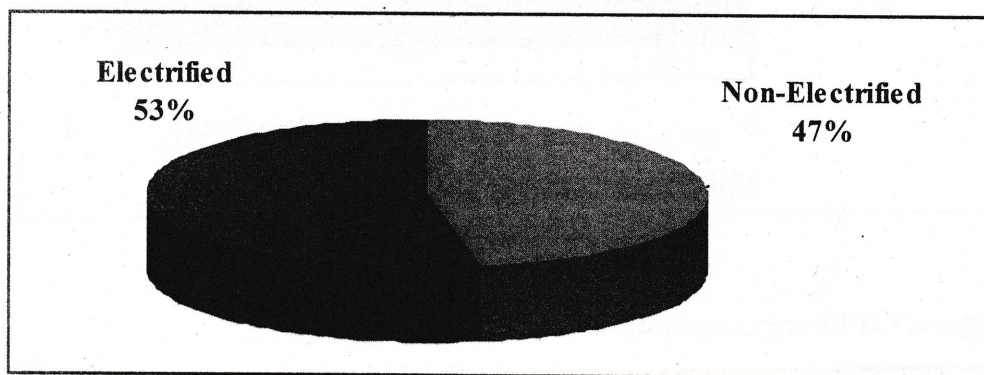
Figure:VII Energy consumption in Industry



Some other interesting information is as follows: Electricity (through hydropower or oil) accounts for only 16 % of the total energy consumption in Sri Lanka. Only 53 % of Sri Lankans have access to electricity (Fig VIII). Fuel wood gathered at the

domestic level still accounts for the largest slice of energy consumption, forty five percent. Industries, as one would expect, are the largest sector-wise consumers of electricity (42.7 %). Domestic users consume 35.9 % of all the electricity.

Fig. VIII : Situation of Electrification of Sri Lanka



3.2.2 Grid-connected electricity sector:

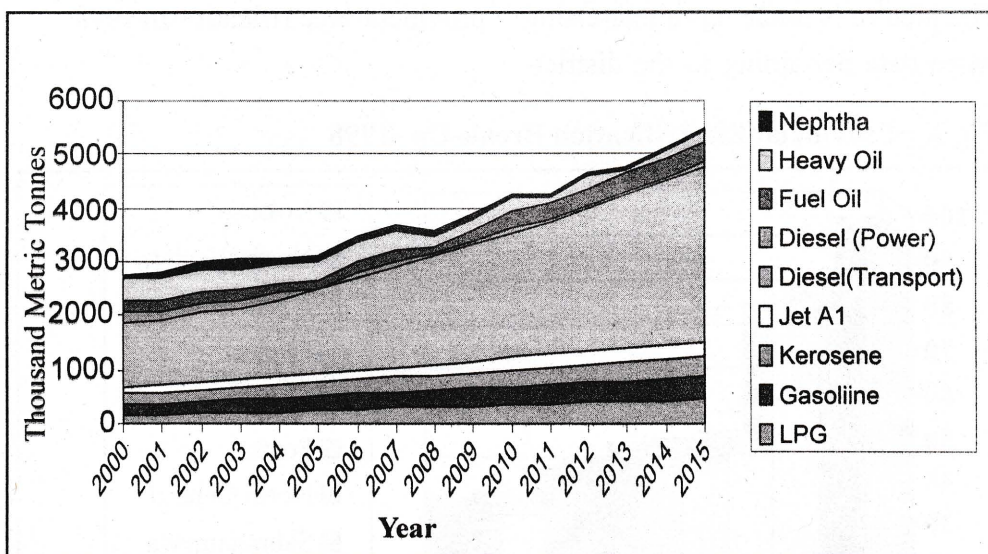
The demand for grid-connected electricity has been growing at a rate of 8-9 % annually during the last few years. At the end of year 2001, the maximum demand was 1445 MW and the annual energy sold was 5236 GWh. As has been mentioned earlier, much of the major power potential has already been harnessed. Up to 1995, the bulk of our electricity needs was

produced from hydropower. The bulk of the additional demand is met from thermal sources. (Figure I).

3.2.3. Petroleum sector:

The demand for petroleum products is shown in Figure IX. This is based on the assumption that the bulk of the thermal based electricity in the future would be generated from coal. As this has not yet materialized, the demand for liquid fuel is likely to increase.

Fig IX : Demand for Petroleum Products



3.2.4. Electric Power requirement in the next fifteen years:

The demand for electrical energy increases continuously with the economic development and with the increase of population. During the

past twenty years, the demand for electrical energy has been increasing at an average rate of 7% per year. In other words, the demand for electricity is supposed to double every ten years.

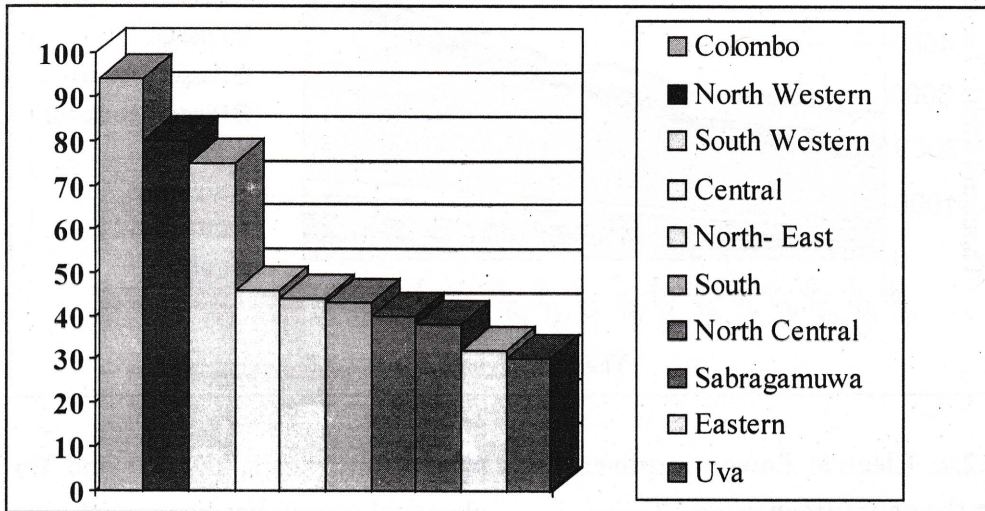
**The country's present electric power requirement is 1340 MW
Its power requirement in year 2015 is estimated to be 3500 MW**

3.2.5 Concentration of Consumer points:

The picture is made more interesting when data pertaining to the district-

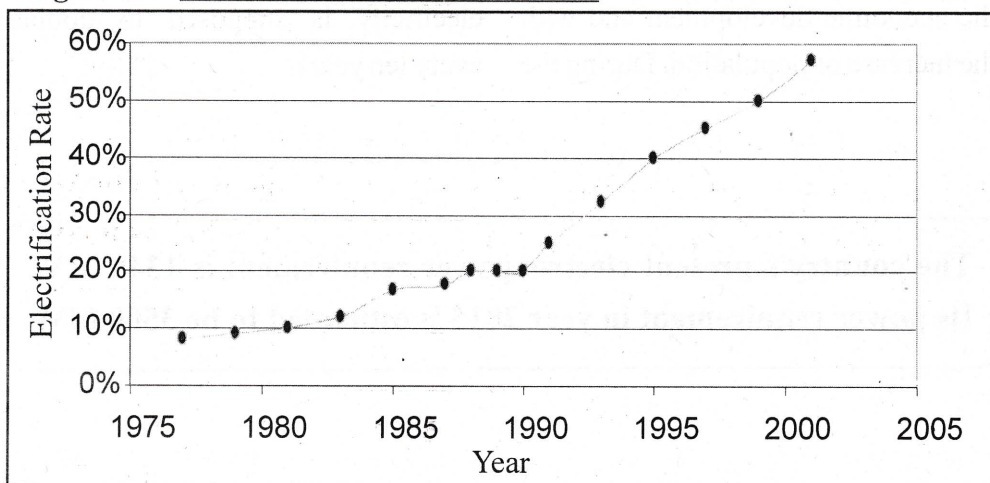
wise supply of electricity is examined. Figure X illustrates the provincial electrification in 1998.

Fig X : Provincial Electrification Break-Up -1998



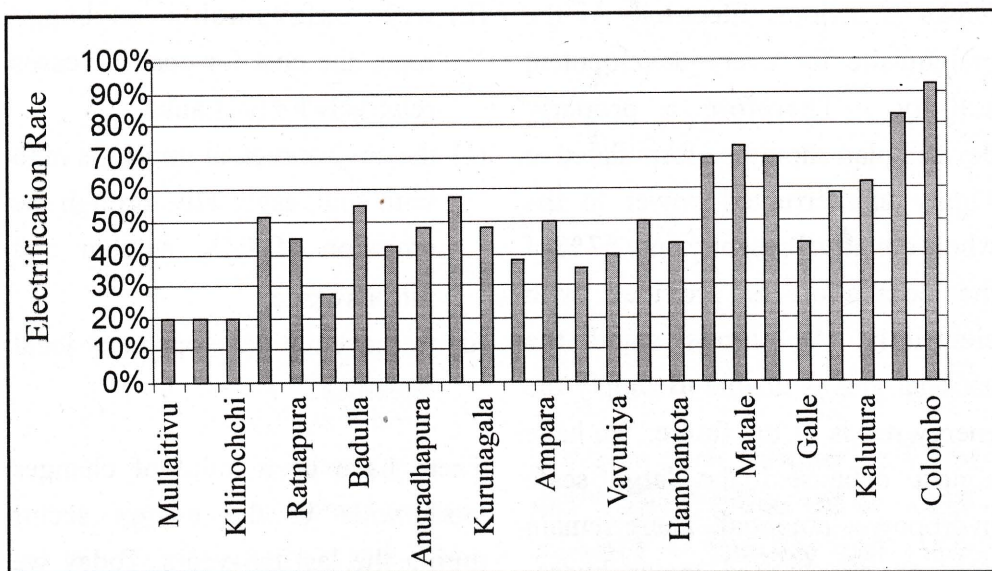
The growth of Electrification Rate in Sri Lanka is shown in Fig XI :

Fig XI: Growth In Electrification Rate



Electrification Rates for districts is shown in Figure XII:

Fig XII : Districtwise Electrification Rates (2000)



Over 90% of the District of Colombo has a regular supply of electricity. Outside the Western Province the story is quite different, with less than 50% of the area being covered by the national grid. In some cases, such as the Uva and Eastern Provinces, the number is less than 30% ! Mullaitivu and Kilinochchi districts have a proportion less than 20%. The main reason for this,

according to some, is the higher cost of providing electricity to such regions. Factors such as low population density are said to be responsible for this situation.

Disparity also exists amongst the urban, rural and estate sectors.

The following table (Table II) shows the average cost per household of extending the grid in the Uva Province:

Table II: Cost of extending the grid :

District	Total Cost Million Rs.	Cost per house (Rs.)
Badulla	1.317	33,245/-
Monaragalla	2.749	58,811/-
Total	4.066	47,514/-

3.2.5. The overall outlook:

Clearly, the energy situation in Sri Lanka is serious. Electricity is the prerequisite for every development activity. Therefore a properly devised plan should be formulated to supply uninterrupted power to the whole country. Presently only 57% of the population is provided with electricity. As things stand the national grid is unable to supply the energy needs of the future. We have almost exhausted the large scale hydropower potential. There remain only a very limited major hydro-generating sites for exploitation. We now depend on the hydros, which are cheaper to run, and several committed oil plants with the CEB and private sector, which are more expensive to run.

The CEB's proposal for a long-term solution to the energy crisis is coal power. This proposal is based on 'least-cost' equation. Coal is a low-cost energy source when cost is calculated as Rupees per kw-hr. However, there are several reasons to reject this stand:

- (a) coal is not an indigenous energy source.
- (b) with unfavourable exchange rates, the cost for coal increases relatively for Sri Lanka.
- (c) the environmental impact is high with coal, especially through the emission of CO₂, sulphur and nitrous oxides.
- (d) we have not developed any local expertise.

There have been a lot of changes world-wide in the energy sector during the last ten years. Today we talk of '**carbon trading**', a topic not discussed ten years ago.

The Clean Development Mechanism (CDM) offers additional motivation to reconsider coal. CDM offers financial incentives for developing countries to choose eco-friendly energy paths by paying for "carbon avoidance". To claim this credit, the Government must establish a baseline projection of carbon emissions determined according to power, and then replace coal with more environmentally friendly alternatives. If CDM credits are included in

the cost equation, the price for coal is higher still.

As a result of the carbon-trading concept, renewable energy technologies have gained fresh importance over environmentally destructive coal power. Long-term solutions to Sri Lanka's energy crisis require looking seriously at renewable energy sources. Many renewable energy sources are indigenous to Sri Lanka, so they require no foreign exchange and they help to develop local skills/resources.

Although there have been attempts to use alternative energy sources as mentioned later, on the whole, there is a conspicuous absence of a concerted effort by all concerned agencies towards creating a collective approach. As such there is a need to implement a comprehensive programme to address the issue. It is absolutely necessary for the national network of power lines to be expanded to the rural areas in a productive manner. Here the priority should be to supply electricity to areas whose location is amenable to less costly transmission. National needs and not personal loyalties should drive

such projects. It is also important to use alternative forms of energy from resources in the area to provide for the energy needs of isolated villages and households in places that are too remote for energy to be supplied from the national grid at low cost. These should include micro-hydro electric schemes, solar power, biogas, fuel-woods, paddy husks and wind power.

4. Present status of the use of Alternative Energy (AE) sources in Sri Lanka:

4.1. Present applications of AE in Sri Lanka:

It is in the context of the facts discussed above the renewable energy options should be considered. It is heartening to note that over the last four years or so there has emerged a slow but steadily increasing demand for energy generated outside the traditional hydropower and thermal systems.

Present applications of AE sources and technologies in Sri Lanka are given in Table III. About 1% of the households in the country benefit by these facilities.

Table III:

AE SOURCES & TECHNOLOGIES	PRESENT APPLICATIONS	REMARKS
Grid connected Micro Mini Hydro	17 units; 24 MW; 65GWh/Year	Cheaper than oil based electricity
Off-Grid Micro Hydro	120units; 5000 households.	Cheaper than oil based electricity, but more expensive than grid electricity. Justified for remotely located communities.
Grid Connected Wind Generators	3MW, 3.3GWH/ year	More expensive than oil based electricity
Solar PV	16000 Solar Home systems.	More expensive than oil based electricity. Justified for remotely located houses.
Biogas	Household Cooking Over 1000 units	Suitable for rural agricultural communities.
Solar Thermal	Household Water Heaters, Agricultural Dryers	Justified if installed during house construction. Very cost effective. Needs popularization.
Thermal Biomass Gasifier	Industrial Heat demonstration facility Two Nos.	Very much cheaper than furnace oil. Needs publicity. Needs technical improvements to exteind application.
Dendro Power for Grid Connection	Feasibility Study for a 500 kw plant ready	Cheaper than oil based systems.
Dendro Power for Off-Grid	35 kw Demonstration plant in operation	Cheaper than oil based off-grid systems.

Of all the alternative energy options, five are important at this juncture. They are discussed below. Others have been experimented with laboratory scale devices and only pre-feasibility studies have been carried out to harness them.

Mini hydro plants are useful and less expensive sources and the Ministry of Power and Energy is implementing a program to harness many small waterfalls. Alternatives such as wind, solar-photo-voltaic and biogas are important in specific isolated locations. However their contribution at present and during the next few decades will be minimal in the context of over-all electricity needs of this country. It appears that the Biomass energy sector is the most promising one for Sri Lanka at this moment. Therefore Biomass sector will be discussed in detail later.

4.1.1 Mini hydro projects:

The power crisis can be minimized to a good extent by utilising small-scale waterfalls. There are about 120 off-grid micro-hydro plants. These are

owned by Off-grid Community based Organisations. It is estimated that there is potential to develop a further 853 plants with a total capacity of 37 MW.

4.1.2 Solar PV (Photo Voltaic) Systems:

In 1980, the CEB initiated a programme to popularise the use of Solar Photo Voltaic (PV) panels to provide electricity to rural households located in areas far away from the national grid. Over 16,000 households have been provided with solar PV modules. There are about 12,000 households using solar water heating systems. Solar heating systems currently consume around 50 units per month.

4.1.3 Bio-gas Producing Units:

The utilization of organic material in biogas digesters results in the production of organic fertilizers. The proper application of organic fertilisers in our farming systems will improve soil fertility and productivity. Around 300 bio-gas producing units have been set up in the country over the past two years.

4.1.4. Wind Power Systems:

Utilisation of wind energy causes environmental problems such as noise pollution and impact on migration of birds. These could be minimized by the appropriate selection of site and design of the windmill.

Wind power has been the fastest growing energy industry in the world for the past decade, sustaining a growth rate of 25%. Whereas 17,800 MW of power was generated from wind in year 2000, the power generated in year 2001 was 23300 MW. (One year gain of 31%) Since 1995, worldwide generation of power from wind-energy has increased five-fold. Despite this spectacular growth, there is still a vast potential for wind power that remains untapped.

In Sri Lanka, there is one grid-connected wind power system, located in Hambantota, with a potential of 3MW. In addition, ITDG has launched two projects, one in Venivelara producing 2.5 kW, and one in Usgala, with two systems, one

producing 1 KW (supplying three households) and another producing 200 W (for one household).

4.1.5 Biomass/Dendro Projects:

Biomass is the single largest source of primary energy in Sri Lanka. As mentioned before it accounts for 53 % of the total primary energy. The total amount of biomass fuel consumed annually is 16 million tonnes. This is about 5 million tonnes of oil equivalent (5 m TOE). Based on current market prices, its total value is Rs. 24 billion. If we replace this with imported oil, we would require US \$ 800 million annually. This is more than what we earn by tea exports. Of this 80% is used in the household sector for cooking meals. The balance is used in industrial sector, in activities such as manufacturing of tea, coconut products and tiles.

Fuel-wood could be used as fuel for thermal generation of electricity. But this does not mean chopping down and burning the forest trees. Now, fuel-wood farming, a new form of agriculture, of quick-growing, and

coppicing trees grown by farmers specifically for fuel, has shown up as the fastest developing and most environmentally harmless source of energy in the United States, in Scandinavia, in Europe, in China etc. Fuel-farming is particularly well suited to the humid-tropical region like Sri Lanka.

Use of fuel-wood in electricity generating plants is not only a more viable and economic way to generate power but also to preserve the environment. While fossil-fuelled (ie. Coal, oil and gas) generators **always**

and **continuously** spew out tremendous volume of CO₂ into the air, contributing to global warming, the CO₂ exhaust from wood-fuelled generators has been **totally** absorbed while the trees were growing. Thus it is well proven to be totally CO₂ neutral. Therefore this is the most environmentally benign of all forms of thermal power generation.

The distribution of land area in Sri Lanka is shown in Table IV. 1.7 million hectares of sparsely-utilised haena and scrub lands have been identified all over the country.

Table IV:

Natural forest	1,678,000 ha	26%
Forest Plantations	81,000 ha	1%
Industrial Plantations (tea, rubber, coconut etc)	769,000 ha	12%
Paddy Lands	799,000 ha	12%
Sparsely used crop lands (‘haena’ lands)	1,263,000 ha	20%
Range scrub land (‘scrub’ land)	502,000 ha	8%
Others (Urban, housing roads, shores, river-reservations, mountains)	1,408,000 ha	21%
Total land area	6,500,000 ha	100%

The location of land available for further energy plantations are shown in Fig XIII (Forestry Master Plan). Although not suitable for the growing of food crops, most of this ecological terrain (28 % of the total land area) is well suited to the farming of fuel wood.

Fig XIII: Distribution of sparsely-utilised scrub lands in Sri Lanka:



Many fuel-wood tree species have been identified as **SRC (Short Rotation Coppicing)** through trials by our Universities and departments of both Forestry and Agriculture for suitability to the various agro-climatic zones of the country.

Most of these are 'nitrogen-fixing' and therefore of special benefit to the soil.

Coppicing a term used to define the ability of certain trees to throw out a profusion of branches (coppices) from just below the level when 'lopped'. The coppiced branches are themselves **lopped** (harvested) when about one or two inches in diameter. This is the ideal size for use as fuel-wood. (We don't have to wait until the tree grows into a large trunk).

The high production way of growing this fuel-wood is to plant them at high density of about 1-2 m apart. First lopping generally takes place in about a year and at about four or five feet off the ground. Lopped

branches are handled like sugar-cane, dried for a week in the sun and then loaded to a trailer (or cart) and then tipped directly into the loading hopper to be fed into the furnace.

Within about six months or so, fresh branches (coppices) have grown radially and upwards from below the initial 'lopping' of the tree and are ready for harvesting once again.

Modest yield is 20 tonnes/ha/yr. Therefore 500,000 hectares (one third of the 1.7 million hectares) would provide 10 million tonnes of fuel-wood annually. This is sufficient to produce 10,000 GWh of electricity annually (nearly twice the hydro power potential of the country) from about 1200 MW. Each power station will have capacity in the range 1-20 MW. The wood-fuelled power stations will be located throughout the country.

If this is done it will save Rupees 15 billion in foreign exchange to import the polluting fossil fuel in order to produce the equivalent amount of thermal energy.

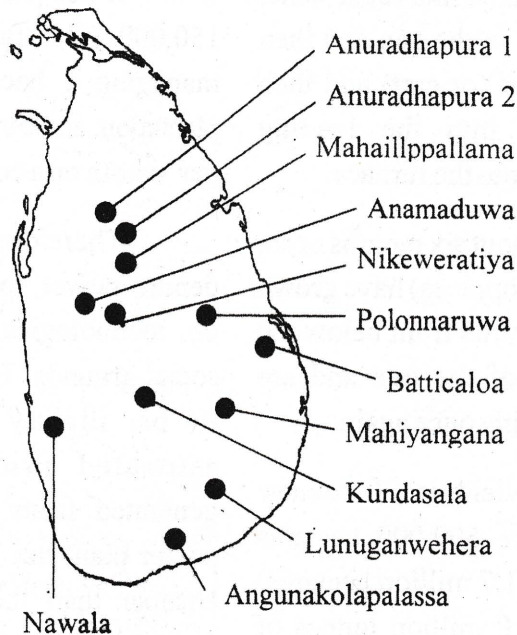
It will provide employment to 150,000 rural families each family managing 3 hectares of fuel-wood plantation, and earning about Rs.7500/- per month on a continuous basis.

Therefore community based dendro power appears to be feasible on technological, agricultural and social grounds. The cost is estimated to be slightly higher than the estimated price of electricity generated from a large coal-based power plant but it is still very much cheaper than the present oil-based power plants. It should be remembered that fossil-fuel based electricity is very likely to escalate in cost with further currency devaluation.

The European Community is offering assistance to generate electricity from fuel-wood. At present the World Bank has agreed to provide finances to have an energy plantation of 2000 hectares.

At present there are twelve experimental (pilot) stations located at places shown in figure XIV.

Fig.XIV: Location of the Experimental (Pilot) stations:



4.2.AE Projects under implementation:

- * The Ministry of Power and Energy has obtained US \$ 70 million (approximately Rs.6950 million) to install over 100 micro-hydro power plants during this year.
- * Under a new programme, with funds provided on a loan scheme by the World Bank (Global Environmental Facility) WB/GEF through the Administrative Unit of the DFCC Bank, it is proposed to provide off-grid electricity to rural

areas. Under this scheme, a total of 100,000 households and 1000 rural small and medium enterprises and public institutions will receive access to off-grid electricity in the next seven years.

- * A third wind power project has been planned for Kirinda to produce several 1kW systems.

Around 4% of the total households in the country could obtain electricity in this manner. Table V gives the number of households provided with off-grid electricity on a district basis.

Table V :

District	No. of Households with Solar Home System	No. of Households with Village Hydro Schemes
Ampara	568	-
Anuradhapura	1,199	-
Badulla	2,043	98
Batticaloa	22	-
Colombo	64	-
Galle	359	-
Gampaha	38	-
Hambantota	331	-
Jaffna	8	-
Kalutara	81	-
Kandy	187	-
Kegalle	176	1461
Kurunagala	1,775	-
Mannar	11	-
Matale	567	-
Matara	314	121
Monaragala	4,236	40
Mullaitivu	4	-
Nuwara Eliya	246	-
Pollonnaruwa	616	-
Puttalam	488	-
Ratnapura	1,737	201
Trincomalee	157	-
Vavuniya	49	-
Total	15276	1,921

4.3.Scope for future applications:

At present, in the whole world, renewable energy represents 5% of all primary energy use, but by the year 2060, it is predicted, with confidence, that it will reach 70% of total energy consumption.

In Sri Lanka, based on the present status of technology and the progress being made internationally, the scope and potential for various AE technologies are given in Table VI. Short term refers to a period of 5-10 years and long term refers to a longer span time.

Table VI: The scope of Alternate Energy Technologies

AE Source / Technology	Technical Potential	Commercial Potential	
		Short-Term	Long-Term
Dendro Power	4000-5000 MW	1000 MW	4000MW
Micro Hydro	1000 MW	250 MW	500 MW
Wind Generators: On-Shore	400 MW	Very limited	200 MW
Wind Generators: Off-Shore	Very Large	Difficult to predict	1000 MW
Biogas: Cooking	1 million households	1000 households	5000 households
Biogas:Compressed Methane for Transport	0.5 million Tons of Energy	Nil	0.4 million Tons of Energy

Bio-Diesel/Bio-Oil/ Bio-Methanol/ Bio-Ethanol	At the expense of Dendro Power	Nil	Difficult to predict
Wave	300-500 MW (Estimate only)	Nil	50-100 MW
Solar PV-Solar Home Systems	Very Large	250,000 households	250,000 households
Solar PV- Hydrogen Production-Fuel Cell Applications	Very Large	Difficult to predict	Difficult to predict
Solar Thermal Water Heating, Agricultural Drying	Very Large	2,500 households	25,000 households

5. The Immediate Options:

It is necessary to plan very well to overcome the crisis situation in the energy sector. Three issues are identified:

- (a) the issue of avoiding power cuts during the dry season of the year for those who have access to national grid supply.
- (b) the issue of having a power cut

of 24 hrs a day right throughout the year for 40% of the Sri Lankan population. ie. for people who do not have access to grid electricity.

- (c) the issues involved in the non-electricity energy sector.

A well planned comprehensive solution is needed to these complex issues.

5.1.Short- Medium- and Long Term Policies:

Even with strict demand-side management, Sri Lanka must increase its generation capacity, a process with short, medium and long-term aspects.

5.1.1 Long-term Policy: Reconsider Coal

As has been mentioned before, the CEB's proposed long-term solution to the energy crisis is coal power and there are valid reasons for reconsidering the coal option. I have already dealt with this matter. In the choice of fuel and technology for energy generation based on "Least Cost Option", all social and economic impacts, such as employment opportunities, drain of foreign exchange etc are overlooked.

We should examine why different countries are adopting different energy options. France is mostly nuclear. Australia is mostly coal based. The British are switching between coal and gas. Japan has diversified their sources. Likewise

our energy option too should be focussed on the overall impact on our economy.

Developing alternate energy sources that have the potential of saving foreign currency, while satisfying the energy requirements of the people, will be the key answer for a long-term solution. Many of these renewable energy sources are indigenous to Sri Lanka and require no foreign exchange. They also help to develop local skills/resources. Therefore the government should provide maximum assistance to develop alternative energy sources such as micro-hydro, Biogas, Solar PV, Solar thermal, Wind, Biomass and Dendro as they require more research before wide scale implementation.

5.1.2 Medium-term option: Coal

Coal may still have a place in Sri Lanka's medium-term energy policy. Since coal plants can be implemented relatively quickly, coal can help make up for lacking generation capacity and it can do so relatively cheaply if

we consider only the initial costs. However, this can only be seen as a medium-term solution. Three coal power plants at Noraichcholai, Trincomalee and Hambantota, which could produce a total of 900 MW still have a place, in the medium term option.

5.1.3 Short term option : Petroleum Generators

In the short term, we are sadly left with no choice but to aggressively control the demand and settle for petroleum (diesel) generators.

This is the current *de-facto* solution to the energy shortage, which has to be accepted regardless of whether one agrees with the strategy at least until demand and supply are equalised.

6. The need of the hour: A National Energy Policy and a National Energy Network to develop resources at regional level

At any rate we cannot be pleased with the progress being made

in the field of energy. Our inability to find a quick solution to the energy crisis attests to the complexity of this national problem. For Sri Lanka to emerge successfully from the energy crisis the issue of energy deficiencies should be addressed in a way that accounts for diverse needs and interests. A pragmatic solution to the crisis demands political and social negotiation as well as technological and economic expertise. Assigning blame to any one group of decision makers, or following the advice of only one government body, worsens the problem by promoting narrow decision-making.

To address the energy crisis, the country needs a fair, consistent, viable and widely accepted national energy policy. Last year the present government had established a new government agency called the National Energy Council (NEC). It is hoped that the NEC will spearhead the formulation of a national policy with a national vision on energy.

Discussion and systematic study on the issue at the regional level

is very essential. The Provincial Councils or future Federal Governments should undertake the initiative and take steps to harness alternative energy resources in order to ensure availability of power for the long term and to provide for the needs of those households bypassed by the national grid.

Democratic decision-making can be both a political and national process. Private electricity generators, environmental forums, energy NGOs, and the consumer societies all have a role to play in working together to address the energy crisis. A cohesive, broad-based energy network is the surest path in terms of cooperation surrounding energy decision-making.

Long-term solutions to Sri Lanka's present energy problems also require a National Energy Network. ie. a strong linkage among all elements of the sector: Policy makers, Researchers, Energy users, and Technology suppliers. The National Energy Network may consist of representatives from all sectors and all levels of the energy community as

indicated below:

- **Private Sector:**

Solar Industries Association,
Micro-hydro developers,
Biogas developers,
Solar dealers and others.

- **Government :**

Ceylon Electricity Board.
National Engineering Research and
Development Centre
Energy Conservation Fund.
Ministry of Science and Technology
(Alternate Energy Unit)
Central Environmental Authority,
Ministry of Environment and
Natural Resources.
Provincial Councils and others.

- * **Civic Society:**

Intermediate Technology Develop-
ment Group
Environmental organisations
Electricity Consumer Societies
Off-grid Community -based
organisations
Energy researchers (Universities etc)
District level NGOs and others.

The National Network should address the following issues:

- Organisational restructuring of the CEB

- Electricity tariff policy changes
- Best technology mix to meet long term energy needs.

The goal of the Network need not be aimed at resolving the differences of opinion but to openly discuss a range of viable energy options for Sri Lanka's energy future.

7. Concluding Remarks:

Energy crisis is closing in on every developing nation in the world. What we encounter today is just a challenge. The real crisis is ahead. It is only with sufficient planning coupled with adequate investment and good management we could overcome the impending crisis.

In his book 'Technology for Development', the renowned Harvard scientist Nawaz Shariff writes as follows:

' ... capacity to produce and adapt technology is more important than mere technology itself. The prosperity of a nation depends not on the quantum of technologies it has amassed but on its ability to adapt and generate technologies'.

Such 'adaptation' must necessarily mean 'to our own natural and sustainable resources, as well as to our social and economic circumstances'. Science in Sri Lanka must necessarily commence with scientists taking a lead in helping exploit the vast resources with which this country is blessed.

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Factors Influencing The Equilibrium Of Concept Formation With Special Reference To The G.C.E(A/L) Physics Learning By Jaffna Students

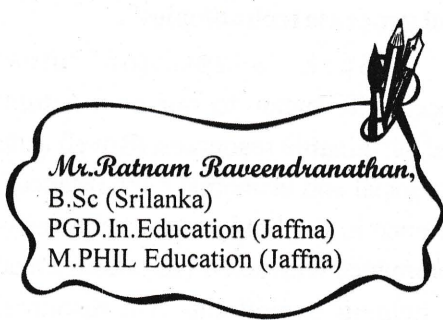
0.0 Introduction:

What matters in Jaffna Society?

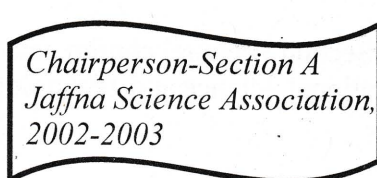
It is the ego and the ego- centrism that matters here in everything in Jaffna society.

Ego of a society is like the ego of an individual. According to Sigmund Freud's personality theory, 'ego' is one of the three components of human personality. 'Id' and 'super - ego' are the other components. The 'id', almost wholly within the unconscious mind, consists of man's instinctive drives and natural tendencies; it is amoral, infantile, non-rational, and demands immediate satisfaction. The super-ego, is an unconscious survival, called conscience. The ego is what we call consciousness; (will, reason, wisdom, sanity)

Ego is in contact with both the id and the external world and the function of ego is to hold a balance between the constant striving of the id for satisfaction, the censure of the super - ego and the demands of the outside world.



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Do we know the function of super ego?

The speaker is of the opinion that this super ego is the personality trait which has the invisible channel to metaphysics because super - ego is known as conscience with unconscious survival.

Intuition for science and science findings is well spoken in the history of scientists and their science work. Human knowledge is a tree, the trunk of which is physics and the root of which is metaphysics. (Roger Scruton, From Descartes to Wittgenstein (A short History of Modern philosophy), Routledge & Kegan Paul, London, Boston and Henly 1981) (P.30).

"The super - ego seems to be to criticize the ego and make it conform by bringing about feelings of guilt"

So ego means the conscious self, as far as an individual is concerned. The concept of a 'society ego' is then a possible hypothetical assumption for us to understand easily the **ability trait** of a set of people who constitute a society. Actually speaking, personality of what is improved by life and life experiences - I mean by learning?

Personality development is required by whom?

It is the ego that interacts with the world and faces problems. In solving problems it gives him wine and super - ego laughs at his slips or appreciates his justice done correctly. So it is the ego that involves and evolves and thereby ought to develop its personality.

The sum total of such personality, attained, could then be considered as a '**society personality**'.

It is the ego and ego - centric nature that rules the psychological as well as the philosophical climate of Jaffna society.

This egoistic nature is centered on educational qualifications, achieved, or to be achieved as 'Jaffna ego' seems to be destined for designation based on such paper qualifications.

The socio - economic structure, the socio - political structure, the ethnic strength in and out of the country that it belongs to, the unique culture and cultural practices that it observes, the norms and demands particularly required in matrimony are some of the factors for the establishment of such special kind of ego of Jaffna, to support a destiny as education for earning a life in the absence of various other opportunity channels and revenues.

Self - Esteem is another factor that comes to play the closest role with this willed ego making a stable contribution from the super - ego to affect the emotional domain in the right direction towards Dharma.

In educational principles regarding the society and education titles, it is emphasized that 'a man evolves as how the society is'. In that case it could be reasonably assumed that the

- 1) Will
- 2) Wisdom
- 3) Activities

of an individual are all decided by the society which he/she belongs to.

Impression derived:

- 1) An individual ego of physics learning student of Jaffna for recognition needs to uplift its standard only through higher studies.
- 2) The desire body of Jaffna students has to have a key thought for possible higher education.

0.1 Understanding the Psychological Problems of G.C.E(A/L) Physics Learning Boys and Girls:

- 1) His/her society imposes only one major line of life though it has many more walks in reality due to the nature of ego of his/her society - that is, that a compulsion for learning is projected on boys and girls by their society.

2) The G.C.E(A/L) common examination to be faced by these students is highly competitive because of the fact that the competing population is high, and the allocated vacancies are either limited or demanding more aptitude ones or gifted ones. By the by physics is a discipline which is meant only for the gifted ones.

3) Number of shies of tries is limited to three.

4) 'Jaffna ego' rewards admissions for faculties of medicine/ engineering than that of other disciplines

5) Job opportunities after graduations are assessed and faculty complexes are thought upon well before materialization, if is to, by each other with half baked knowledge or by unwise desire anticipations developing a pricking factor for students.

6) Self interest and self aptitude shown subject combinations are denied by outside will examining the demand of the society then and compulsion of learning a subject chosen by other hands is imposed or promoted.

7) What may happen to the future of a Jaffna student in the Jaffna society, whom we suppose that he fails to enter into higher studies (in general) finishing all three attempts to his abilities and capabilities or capacities? Whether alternatives are possible? Even if possible is it possible to every

body coming into this class or category that is already big in size? Don't we think that these are thoughts which are influencing or going to influence when he or she happens to think of this at a stage of his study? Won't this thought if had been submerged already within the unconscious phase rise up to disturb involvement of the child in learning concepts in physics? or to make him moody then and there causing the teacher not to choose the time of teaching him? or for the boy to choose his own time of learning? Choosing his own time of learning is because his state of readiness occurs at that phase just after overcoming the anxiety or freeing from the above stress? whether the arrangement or package of teaching concepts in a formal education could be then successful than that of the private tutoring centers that cater to the students who select their own time of learning?

- 8) How about his or her likings and dislikings? of day to day life? his leisure engagements particularly privacy cravings?

What could these poor children do when the secretions of necessary sex glands go for good amount of secretions. How long could you delay or stop this state of all 24 hours

readiness for sex sensing and procreation? Is it their mistake?

If Jaffna ego goes for punishment practices over these adolescents intentionally having taken his good future prospects into account to delay the reward for expected achievement, his sensory system also may engage less in learning things, then? Isn't it?

So in learning concepts in physics these senses need a forceful or deliberate control by the mind for learning than the mind of sex sensing to concentrate upon what is essential to concept and conceptual learning to the exclusion of the appealing sex impulsing eyes appearing in his environment (S-R bond theories could be recollected here), (because this is stimuli causing response)

Educationists, when introducing theories of instincts they say that this natural violent secretion of sex temptations is a sign that the child is ready and ready for creation by both body and mind and therefore learning concepts takes creativity and constructivity in this their stage of adolescence. Apart from the state of readiness the development of the ability of learning difficult concepts (in physics) in complex situations qualifies for a higher order of thinking such as cognitive orders or as even epistemological orders.

What the speaker wants to focus here is that for which, what the state of readiness or the state of attention or the state of interest to involve specially in problem solving - say - is what it is wanted as a pre condition.

Definitely it is true that this triad stage of development - that is, the development of physique, the development of intellect and the development of emotion - within among together in the active region of play as you know like a transistor, towards an analysis or logical reasoning type of learning which is the learning style and way in entire physics curricula experiences sheduled to this G.C.E(A/L) boys and girls, in a full form of work load.

But again then, the phase co-ordination within there three strands of this triad may get upset (or clipped as you know in a transistor) then and there, damaging the continuity and systematic learning processes of concepts the way they were revealed in physics work by nature.

Now what do you think of a course of learning which does not give the assurance of success at the end of it even with three shies of chances to attempt to attempt and also the mental suffering of the vibrant who is aware of such which well ahead before entering into, while

following as a course of full time also. G-C-E (A/L) course is in this caliber.

Don't we think that the probability chances for anxiety development is chancier heavily if the child was not confident enough to be convinced by the unconscious part of the mind very particularly with the number of better-very much better successes in learning physics concepts which he thinks that what the concept that he has learnt is once and for all learnt and stable in equilibrium.

What do we think of those students who think who is responsible of his own members' liabilities (sister) in time to come, before to follow a course of no assurance for a sure success at the end of it.

So becoming before, the imposed pains are anchored with these students.

Observation by speaker:

'The state of readiness for sex impulses from the body use to come first than from the mind' was the case for past generation but it is mostly other way round for the present generation, and also little early.

Due to absentia of the steady earning opportunities the upper margin of the state of readiness for sex problem to properly start a life for sex and

procreation among decent ones is further dragged to cause a big interval of time delay.

NOTE: only 10% of the human motives are in the conscious and the sub conscious minds. Motives hidden in the unconscious mind influence human behaviour. the majority of the feeling in the unconscious mind are hidden or embedded during child - hood. Such repressed feelings cause frustration. The majority of these feelings are linked with unfulfilled sex impulses and aggression.

-Sigmund Freud

NOTE: Let us now connect the R-S theory of B.F.Skinner - Free operants emitted responses from within.

Question: Why do the majority of the physics learning students both responsibility holders of the family (mostly boys generally) and the liabilities of the family as it is stamped by 'Jaffna ego' for its own culture fail and only a handful make it success in relation to R-S theory not by S-R theory? then what should be the direction of the move of the educators or teachers of the society as a whole including the

physics teaching teachers of school society.

Problem

Summary, or point form of the G.C.E(A/L) physics learning students problems discussed so far could be stated as follows:

No alternatives left

except of facing a highly competitive common exam sometimes a sort of discriminative test either

For a life of self - esteem

For a life of ego

For self - recognition of identity

with a high threat of 'do or die' set up due to the norms and destiny of their society with postponing or yielding struggle to sex impulses bearing a burden of responsibility anchored for future materialization or of liability loading for future materializations yearning for mastering or understanding a subject like physics of requiring a high aptitude and intelligence for learning, fighting against anxiety and stress till the success which is not assured is given in an environment where reinforcement practices for encouragement is not mostly healthy, from the expected corners sometimes.

Question:

- 1) Do we understand first of all the psychological factors that form a sort

of inertia of learning irrelevant to subject learning first?

- 2) Do we understand the desire body of the G-C-E(A/L) students?
- 3) Do we understand the degree of their 'feelings for' internalized? and do we understand the dangerous part of this consequences of new g, feelings not liked or strenuous, internalized, in the forgotten survival that is in the unconscious survival for formations of huge apperceptive masses? causing mostly the psychological boost damaged? in learning concepts in physics weakly or only in an exam

point of view of learning rather than in a tasting and learning view? and thereby to deny the room for exam point of view to be a perfect sub set of tasting & learning view for a steady and sure successes of work.

Let me introduce a theory at this context by a pure physicist Gamble, Mr.R. who formulated this theory out of intuitive approach bearing in mind that even good analogies with Newton's second law of motion can more rapidly as it were, in a situation where the 'teaching' has never been quantitatively defined.

$$L = \frac{d(k)}{dt} \text{ ----- (1)}$$

L- Learning
k- knowledge.

For a given pupil

$$T = CL$$

C - Learning inertia

----- (2)

$$F = ma$$

m- mass
a **kind** of resistance
to acceleration.

NOTE

$$\frac{1}{C} = \frac{L}{T}$$

)
ability to
learn science

workings

$$\begin{array}{ccc}
 T = C L & \xleftrightarrow[\text{C = const} \quad m = \text{const}]{\text{(for a given pupil)}} & F = ma \\
 T = C \frac{d}{dt} (k) & & F = m \frac{d}{dt} (v)
 \end{array}$$

$$T = \frac{d}{dt} (CK)$$

↑
Cognitive
momentum



$$T = C \frac{d}{dt} (k) \quad T = K \frac{dc}{dt}$$

$$F = m \frac{d}{dt} (mv)$$

↑
Linear
momentum

"The effect of teaching is to change the cognitive momentum of pupils"

Note: cognitive momentum may have structures within it due to structures within the relevant knowledge.

[eg:- Gagne]

or in pupils' ability to learn

[eg:- Piaget]

Note: $T = \frac{d}{dt} (ck)$

if $T = 0 \Rightarrow d(ck) = 0$

This does not mean that $d(k)$ and $d(c)$ must be zero $k \uparrow \uparrow \uparrow \Rightarrow C \downarrow \downarrow \downarrow$

$\Rightarrow CK$ remains constant.

Note: Every day physics learning LE say we give same questions to Grade 5 & Grade 9
{F?, P?, V?, weight.?, falling under gravity? sound? Heat? etc}

little or

$$C_5 K_5 = C_9 K_9$$

$\Leftarrow \{ T = 0 \text{ no formal instruction is given} \}$

$$L_E = \frac{1}{4}(K_q - K_s) \text{ may be considerable}$$

L_T = formal Learning

$L_E > L_T$ \Leftarrow Result of
APU-Assessment of performance unit
CLISP - The children's Learning In Science projects

\Downarrow
Def \mathbb{N} Learning (L) = f(number of data points and the degree of interlinking)

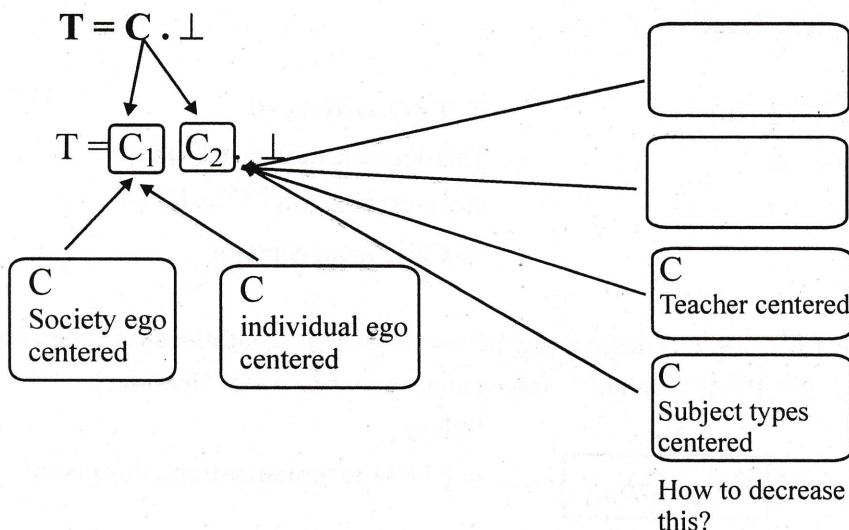
ie

= is the rate of change of knowledge and from the above can be seen to take place by

- 1) The addition of new points
- 2) No addition of new data points but a higher degree of interlinking of existing data points.

clearly effective learning must involve both processes.

insights of the relationships of our problem to this theory



Concepts in Physics:

Length (L), mass(M), Time(T), Temperature difference (Q), current (I) and amount of substance (X_i) are basic physical quantities in physics.

Length is a concept. Length is a basic quantity. Length is a basic concept. Length is a basic developed concept in physics denoted by the capital letter 'L'

Do we understand the concept of Length? How do we explain this idea of length? Width, depth, height, distance, distance traveled, extension of an elastic string or a rubber band or a slinky, the magnitude of displacement, are all measured by the same unit - basic unit of length - meter (notation 'm').

Whether the idea behind the term length is different from that idea behind the term width?

Some may argue that the width has a length and height has a length and even length has also a length, therefore length is a different concept from the concept of width.

For a layman the meaning of the concept length is one but for a physics learning student the meaning of the concept named length is another.

Because he is using a term as length of length. Here the language's part is inadequate or not sufficient enough to help him to carry the differentiated ideas that he is meaning by the first term length and the second term again length.

Regarding concepts, naming a concept correctly is very much essential, it is said. Because for communication of different ideas demand different naming which should not overlap or intersect the other naming meant for another concept.

When we hear the word 'Length we do not conjure up ideas relating to all the different kinds of lengths there are:

To the normal adult, the term length implies a class of one dimensional sizes which can usually be measured for different purposes (measuring the weight is one of the purposes?) with the understanding that length of length, length of width or height are one dimensionally lengthened.

That is to say, the adult has developed the concept of 'length'. Thus concepts enable words to stand for whole classes or categories of quantities in physics, objects in physics, events in physics, eventualities in physics and are of enormous help to physics learners in their thinking.

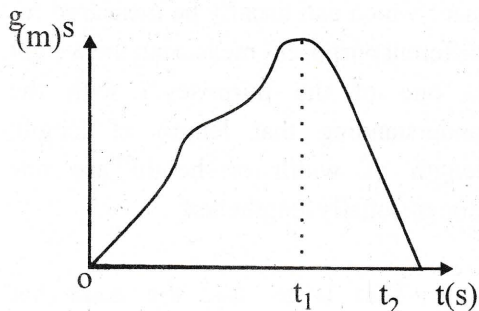
In the 'GCSE' level the wording practised for concepts is confusing students.

For example

In place of 'displacement' the word distance is used and in place of distance, the word distance travelled is used.

This causes two big problems:

- 1) Wording the same concept with different names may create a situation to treat a graph with different treatments perceived by those different words,
- 2) This type of confusion may lead the child to get into the fear of uncertainty over a concept prepercieved even right.



'car is travelling back but the time t_1 and t_2 ' is their message here?

Whether this is correct? whether distance is the correct wording? why is it that they can not engage the right term displacement here?

Actually, this particular example, appeared in ACE publications books where a board of experts in physics govern the presentation, might have been with the motive not to bring in a vector quantity to this level of students since things mostly for memory level is insisted than understanding level.

Thus concepts in physics when enable words to stand, those words should be internationalized first and should not take the functional roll of another concept near to it in time to come. Even ideas are attempted to be named. Every idea conserves itself. It contends with each other. While contending, an idea conserve it self That is, each and every idea strives to conserve itself even in a situation which is propitious to associate with another. It is said that compatible ideas form an apperceptive mass in learning theories, stating mind to be a store of ideas.

A single idea is not always not enough to be known as a concept. Concept may be constituted with many more ideas, for it to be sensible.

Among learning theories, 'Apperception' by Johann Friedrich Herbart (1776-1841) [German philosopher] [Neutral Reactive] is ideal

and effective in understanding concept formation mechanism.

Apperception means, a process of associating new ideas with old ones. Apperception is idea centered. A concept is either an idea or an idea of a set of ideas making a mass known as apperceptive mass or an assimilated idea to other conscious ideas.

Mind is a battleground of contending ideas and every idea seeks self-preservation.

The important thing that we have got to note here is that

- 1) Compatible ideas may operate as teams helping each other to remain in a conscious mind.
- 2) When two ideas are incompatible, however one is likely to be submerged.

For concept formations these are the ideas that play this way a role, and ideas when get assimilated with the old ones that were standing for a particular concept earlier, now with the apperceptive process the new idea incorporated may strengthen the knowledge over that concept now.

That is, for example the knowledge over the concept of friction is less in the junior secondary level but more in the

level of G.C.E(A/L). So knowledge of each and every concept in physics increases more and more when the involvement of problem solving or general learning is more and more as we come across fresh specimens of the concepts.

'Friction opposes the motion' is what the only idea, introduced at junior secondary. In the G-C-E (A/L) the laws of friction come in and static frictions, limiting frictions, sliding frictions, viscous forces, their equations, depending factors, independent factors are all discussed here Identifying not only examples but also non-examples

Tennyson and Park (1980) stress the importance of starting the learning of a concept by school-age children with a definition. The definition should then be followed by both, examples and non-examples of the concept, and also stresses that many concepts are learned in groups that are related (p:289)

So then, what are the factors influencing the equilibrium of concept formations? Let us take the stock on what we have so far thought upon. Every concept particularly new one should be defined

first - well defined first if the kind of such concept qualifies a def"

- 2) Must be correctly worded for there is no room for inaccurate messages
- 3) Examples should be given.
- 4) Non examples should be given
- 4) More fresh specimens should be given for testing and seeing for abstraction and generalization.

For

Concept formation is probably best thought of as a blend of abstraction and generalization. In the former process the features common to a class of objects make their impressions upon the observer, who thus gradually acquires a picture in which the common features stand out strongly and the variable characteristics are no longer noticed. Thus if we have a number of circles of different diameters made of different materials, and painted different colours, the common feature is a circle. In our example of width, height, distance, extension and distance traveled the common feature is one dimensional, space size - named length. And the recognition of this feature in the objects or in quantities constitutes the essence of concept formation. On the other hand, in generalisation, the concept stands as a hypothesis which the observer proceeds to test by trying it out on fresh specimens of the class.

Junior secondary specimens maybe length, width and height. In senior secondary distance traveled and extension or wave length may be fresh specimens. So as far as the equilibrium of concept formation is concerned.

- 1) The first factor to influence in the foundation level is 'society ego' centered good and bad or fast and inertial
- 2) The second factor to influence in the building level is teaching methodology centered good and bad such as defining concepts, properly wording concepts informing examples and as well as non - examples, facilitating fresh specimens.
- 3) The third factor to influence is the trend of the subject concerned. When I was asking the priorities from the G.C.E (A/L) students as far as the expectation from a teacher teaching physics, they said priority one is better explanation and priority two is more worked examples leaving out the priorities of finishing the syllabuses in time, giving full set of notes, doing more number of practicals and conducting more number of practice tests.

Many more subtle analysis and hypotheses and findings of work of such trend impressions were tried at

speakers M.Phil dissertation - a dissertation with the kind permission of Prof.V.Arumugam and the kind guidance of Prof.K.Sinnaththamby.

Why do they demand better explanations in physics learning as priority one at the expense of other wanted priorities, because, concepts,

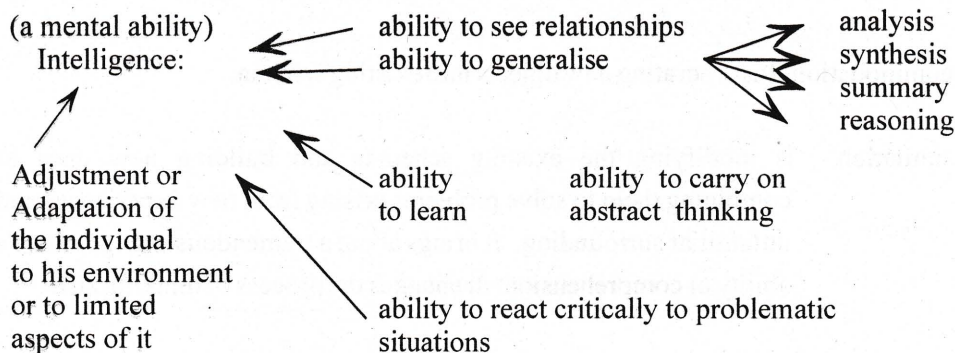
concept formations, the logical scientific structural pattern of wisdom concerned for such special subject then demands a higher aptitude for us to understand the beauty of the subject of physics.

4) What is the 4th factor to influence then in a good or bad way is student centered.

Dependent factors of concept formation

Concept formation is greatly dependent upon

1. general Intelligence
2. Academic aptitude
3. a special ability (According to suggestion by recent works)



- Intelligence
- A - Innate potentiality
(neither observable nor measurable)
 - B - All - round ability in daily life, at school or work
(understanding, insight, of thought, and practical judgement)
 - C - in our culture.

The intelligence is interactionist in essence- Piaget.

1) Why is it concept formation is done

Thinking process is made easier by concept formations.

2) concept development

It is the intellectual development that lays the foundation for concept development

Process of concept formation according to Jean Piaget

Cortex - Exterior layer of the brain. Sense impressions are stored here. Store house of impressions

Schemas - When sense impressions are organised in a sequence or patterns, we call it schema.

Accommodation- Incorporating new objects into existing schema.

Assimilation- is modifying the existing schemas and building new ones or combining them to solve problems arising from new experiences and unfamiliar surrounding. It brings about a tremendous change in one's ability or comprehension. It changes the process of thinking also.

Thinking starts with a problem. Thinking is some thing related to thoughts and thoughts' chain is thinking.

The manner the Goal - Oriented thoughts act

- 1) Production of concepts and shaping their conduct
- 2) Analysis and synthesis
- 3) Decision and theorization
- 4) Perception and imagination.

The key frame of the thought piece

$$L = \frac{d(k)}{dt}$$

L-Learning
K-Knowledge

Analogy (out of Inductive Approach)
By Gamble, Mr R. a physicist.

$$\Rightarrow \begin{array}{c} T \times L \\ T = CL \\ \uparrow \\ \text{Learning} \\ \text{Inertia} \end{array}$$

$$T = \frac{d(k)}{dt}$$

$$T = \frac{d(ck)}{dt}$$

$$\uparrow \\ \text{Cognitive} \\ \text{momentum}$$

NOTE

$$\frac{1}{C} = \frac{L}{T} \\ \uparrow$$

ability to
learn physics

$$\Rightarrow \begin{array}{c} F \times a \\ F = ma \\ \uparrow \\ \text{mass} \\ \text{a kind of resistance} \\ \text{to acceleration} \end{array}$$

$$F = m \frac{d(v)}{dt}$$

$$F = m \frac{d(mv)}{dt} \\ \uparrow \\ \text{Linear} \\ \text{momentum}$$

$$\frac{1}{m} = \frac{a}{F}$$

$$T = \frac{d}{dt} (ck)$$

Grade 13

$$\int T dt = \int d(ck)$$

Grade 6

$$= \underbrace{CK_{G13} - CK_{G6}}$$

The effect = change of cognitive momentum of teaching
(physics) form

Grade 6 to

Grade 13

$$T = \frac{d}{dt} (ck)$$

$$\text{if } T = 0 \Rightarrow d(ck) = 0$$

This does not mean
that $d(k)$ and $d(c)$
must be zero

$$K \uparrow \uparrow \uparrow \Rightarrow C \downarrow \downarrow \downarrow$$


CK remains constant

There are M-mensional views in Education strictly speaking - in the vector field of education. This piece of work, tried thro' me, is left open free for further extensional works. Thank you all very much.

Global Warming and Climate Changes

Climate

Climate in a narrow sense is usually defined as the “average weather”, or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. [The classical period is 30 years, as defined by the World Meteorological Organization (WMO)]. These quantities are most often surface variables such as temperature, precipitation, and wind. Climate in a wider sense is the state, including a statistical description, of the climate system. The climate system is the highly complex system consisting of five major components: the atmosphere, the hydrosphere, the cryosphere, the land surface and the biosphere, and the interactions between them. Atmosphere is the gaseous envelope surrounding the Earth. The dry atmosphere consists almost entirely of nitrogen (78.1% volume mixing ratio) and oxygen (20.9% volume mixing ratio), together with a number of trace gases, such as argon (0.93% volume mixing ratio), helium,



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2003-2004.*

and radiatively active greenhouse gases such as carbon dioxide (0.035% volume mixing ratio), and ozone. In addition the atmosphere contains water vapour, whose amount is highly variable but typically 1% volume mixing ratio. The atmosphere also contains clouds and aerosols. Hydrosphere is the component of the climate system comprising liquid surface and subterranean water, such as: oceans, seas, rivers, fresh water lakes, underground water etc. The part of the Earth system comprising all ecosystems and living organisms, in the atmosphere, on land (terrestrial biosphere) or in the oceans (marine biosphere), including derived dead organic matter, such as litter, soil organic matter and oceanic detritus is Biosphere. Cryosphere is the component of the climate system consisting of all snow, ice and permafrost on and beneath the surface of the earth and ocean.

Is climate changing?

Climate is changing. Climate is a dynamic phenomenon that is always changing. Warming and cooling periods are typical of the cycles of nature. The data we have reviewed appears to indicate that the world has been in a prolonged period of cooling (over

150,000 thousand years), and it should not surprise us if it is entering a period of warming. However, both the speed and extent of the warming are too extreme to be dismissed as "normal," and their correlation to changes in atmospheric carbon are very close. We conclude that human activity is likely contributing to a warming rate that is almost certain to have significant impact on climate.

Energy from the sun drives the earth's weather and climate, and heats the earth's surface; in turn, the earth radiates energy back into space. Atmospheric greenhouse gases (water vapor, carbon dioxide, and other gases) trap some of the outgoing energy, retaining heat somewhat like the glass panels of a greenhouse. Without this natural "greenhouse effect," temperatures would be much lower than they are now, and life as known today would not be possible.. However, problems may arise when the atmospheric concentration of greenhouse gases increases.

Since the beginning of the industrial revolution, atmospheric concentrations of carbon dioxide have increased nearly 30%, methane concentrations have more than doubled, and nitrous oxide concentrations have

risen by about 15%. These increases have enhanced the heat-trapping capability of the earth's atmosphere. Sulfate aerosols, a common air pollutant, cool the atmosphere by reflecting light back into space; however, sulfates are short-lived in the atmosphere and vary regionally.

Reasons for Increase in Greenhouse Gases Concentrations

Scientists generally believe that the combustion of fossil fuels and other human activities are the primary reason for the increased concentration of carbon dioxide. Plant respiration and the decomposition of organic matter release more than 10 times the CO₂ released by human activities; but these releases have generally been in balance during the centuries leading up to the industrial revolution with carbon dioxide absorbed by terrestrial vegetation and the oceans.

There are many reasons for the additional release of carbon dioxide by human activities. Fossil fuels burned to run cars and trucks, heat homes and businesses, and power factories are responsible for about 98% of U.S. carbon dioxide emissions, 24% of methane emissions, and 18% of nitrous oxide

emissions. Increased agriculture, deforestation, landfills, industrial production, and mining also contribute a significant share of emissions. In 1997, the United States emitted about one-fifth of total global greenhouse gases. Estimating future emissions is difficult, because it depends on demographic, economic, technological, policy, and institutional developments. Several emissions scenarios have been developed based on differing projections of these underlying factors. For example, by 2100, in the absence of emissions control policies, carbon dioxide concentrations are projected to be 30-150% higher than today's levels.

Changing Climate

Global mean surface temperatures have increased 0.5-1.0°F since the late 19th century. The 20th century's 10 warmest years all occurred in the last 15 years of the century. Of these, 1998 was the warmest year on record. The snow cover in the Northern Hemisphere and floating ice in the Arctic Ocean have decreased. Globally, sea level has risen 4-8 inches over the past century. Worldwide precipitation over land has increased by about one percent.

Increasing concentrations of greenhouse gases are likely to accelerate the rate of climate change. Scientists expect that the average global surface temperature could rise 1-4.5°F (0.6-2.5°C) in the next fifty years, and 2.2-10°F (1.4-5.8°C) in the next century, with significant regional variation. Evaporation will increase as the climate warms, which will increase average global precipitation. Soil moisture is likely to decline in many regions, and intense rainstorms are likely to become more frequent.

Calculations of climate change for specific areas are much less reliable than global ones, and it is unclear whether regional climate will become more variable. Like many fields of scientific study, there are uncertainties associated with the science of global warming. This does not imply that all things are equally uncertain. Some aspects of the science are based on well-known physical laws and documented trends, while other aspects range from 'near certainty' to 'big unknowns.'

What's Known for Certain?

Scientists know for certain that human activities are changing the composition of Earth's atmosphere.

Increasing levels of greenhouse gases, like carbon dioxide (CO₂), in the atmosphere since pre-industrial times have been well documented. There is no doubt this atmospheric buildup of carbon dioxide and other greenhouse gases is largely the result of human activities.

It's well accepted by scientists that greenhouse gases trap heat in the Earth's atmosphere and tend to warm the planet. By increasing the levels of greenhouse gases in the atmosphere, human activities are strengthening Earth's natural greenhouse effect. The key greenhouse gases emitted by human activities remain in the atmosphere for periods ranging from decades to centuries.

A warming trend of about 1°F has been recorded since the late 19th century. Warming has occurred in both the northern and southern hemispheres, and over the oceans. Confirmation of 20th-century global warming is further substantiated by melting glaciers, decreased snow cover in the northern hemisphere and even warming below ground.

What's Likely but not Certain?

Figuring out to what extent the human-induced accumulation of

greenhouse gases since pre-industrial times is responsible for the global warming trend is not easy. This is because other factors, both natural and human, affect our planet's temperature. Scientific understanding of these other factors most notably natural climatic variations, changes in the sun's energy, and the cooling effects of pollutant aerosols remains incomplete.

Nevertheless, the Intergovernmental Panel on Climate Change (IPCC) stated there was a "discernible" human influence on climate; and that the observed warming trend is "unlikely to be entirely natural in origin." In the most recent Third Assessment Report (2001), IPCC wrote "There is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities."

In short, scientists think rising levels of greenhouse gases in the atmosphere are contributing to global warming, as would be expected; but to what extent is difficult to determine at the present time.

As atmospheric levels of greenhouse gases continue to rise,

scientists estimate average global temperatures will continue to rise as a result. By how much and how fast remain uncertain. IPCC projects further global warming of 2.2-10°F (1.4-5.8°C) by the year 2100. This range results from uncertainties in greenhouse gas emissions, the possible cooling effects of atmospheric particles such as sulfates, and the climate's response to changes in the atmosphere. The IPCC states that even the low end of this warming projection "would probably be greater than any seen in the last 10,000 years, but the actual annual to decadal changes would include considerable natural variability."

What are the Big Unknowns?

Scientists have identified that our health, agriculture, water resources, forests, wildlife and coastal areas are vulnerable to the changes that global warming may bring. But projecting what the exact impacts will be over the 21st century remains very difficult. This is especially true when one asks how a local region will be affected.

Scientists are more confident about their projections for large-scale areas (e.g., global temperature and precipitation change, average sea level rise) and less confident about the ones for

small-scale areas (e.g., local temperature and precipitation changes, altered weather patterns, soil moisture changes). This is largely because the computer models used to forecast global climate change are still ill-equipped to simulate how things may change at smaller scales. Some of the largest uncertainties are associated with events that pose the greatest risk to human societies. IPCC cautions, "Complex systems, such as the climate system, can respond in non-linear ways and produce surprises." There is the possibility that a warmer world could lead to more frequent and intense storms, including hurricanes. Preliminary evidence suggests that, once hurricanes do form, they will be stronger if the oceans are warmer due to global warming. However, the jury is still out whether or not hurricanes and other storms will become more frequent. More and more attention is being aimed at the possible link between El Niño events the periodic warming of the equatorial Pacific Ocean and global warming. Scientists are concerned that the accumulation of greenhouse gases could inject enough heat into Pacific waters such that El Niño events become more frequent and fierce. Here too, research has not advanced far enough to provide conclusive statements about how global warming will affect El Niño.

Living with Uncertainty

Like many pioneer fields of research, the current state of global warming science can't always provide definitive answers to our questions. There is certainty that human activities are rapidly adding greenhouse gases to the atmosphere, and that these gases tend to warm our planet. This is the basis for concern about global warming.

The fundamental scientific uncertainties are these: How much more warming will occur? How fast will this warming occur? And what are the potential adverse and beneficial effects? These uncertainties will be with us for some time, perhaps decades.

Global warming poses real risks. The exact nature of these risks remains uncertain. Ultimately, this is why we have to use our best judgement guided by the current state of science to determine what the most appropriate response to global warming should be.

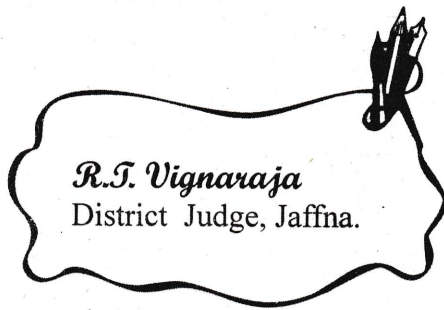
Future Climate

The continued addition of greenhouse gases to the atmosphere is likely to raise the earth's average temperature by several degrees in the next century, which will in turn raise the

level of the sea. There is likely to be an overall trend toward increased precipitation and evaporation, more intense rainstorms, and drier soils. Since 1979, scientists have generally agreed that a doubling of atmospheric carbon dioxide increases the earth's average surface temperature by 1.5-4.5°C (3-

8°F). More recent studies have suggested that the warming is likely to occur more rapidly over land than the open seas. The warmer temperatures are expected to raise sea level by expanding ocean water, melting mountain glaciers, and melting parts of the Greenland Ice sheet.

LAW AND JUSTICE IN CONFLICT TRANSITION



With the cessation of hostilities, the improvement of living conditions in the North and East and the prospect of a permanent settlement to the conflict, hope has arisen for Sri Lanka's thousands of Internally Displaced Persons and refugees of returning to their former places of residence. Indeed, many thousands of IDPs have already returned spontaneously and many more are contemplating doing so. Land and property issues affecting displaced persons and returnees to the North and East have therefore become of critical importance.

Restitution of property, access to land, destruction and landmines, assistance and legal redress are some of the issues identified as pressing land and property challenges facing returnees, the Government, the LTTE, and the international community in their efforts towards restoring normalcy in the North East.

I shall endeavour to give you a fair inside of the complex property issues on

the ground, and the issues anticipated to arise, when the displaced persons and the refugees return to their traditional or original places of residence.

You are probably well aware of the background of the ethnic conflict in Sri Lanka, but I must draw attention to the fact that due to the civil war of the last two decades more than 800,000 persons have been displaced either internally or have fled as refugees to foreign countries. With the cease fire agreement and with the peace negotiations about 220,000 displaced persons had spontaneously returned to their permanent residence. A large number of displaced persons are anticipated to return with the progress of the peace efforts. Almost all the refugees in India and a fair number of the refugees from the western countries have indicated their willingness to return to their permanent residences.

For the safe and dignified return of the IDPs and Refugees to their permanent place of residence, it is essential that the pre-conflict property rights of these persons are respected and restored and an effective and just system is put in place to resolve property rights disputes, including restitution or compensation.

The UN Guiding Principles on Internal Displacement (Principle 21) has emphasized that the property and possessions left behind by internally displaced persons should be protected against destruction and arbitrary and illegal, appropriation, occupation or use. In this endeavour the primary responsibilities lie with the national authorities but under the UN principles the international humanitarian actors too have a major role to play.

One of the major problems that is encountered by the internally displaced persons and refugees who are returning to their permanent residences is the non availability of their house and property for their use and occupation. This is either due to destruction of the property or the illegal appropriation or occupation thereof by unauthorized persons.

The conflict affected areas have been subjected to massive property destruction. They include large number of private properties such as houses, business premises and industries. The agricultural and paddy lands of the IDPs and refugees were neglected and are covered with scrub jungle and need substantial improvements for cultivation. In the Jaffna District alone over one

hundred thousand houses are extensively damaged. Almost all the houses and business premises in the Kilinochchi District and a large number of houses in Mullaithivu district are also damaged. A fair number of houses and properties in the other districts of the North & East are either damaged or destroyed. Without reconstruction or substantial repairs, these houses, business premises and industries cannot be put to use. Requirement of a house for living is a fundamental Human Right and a basic necessity. Most of the IDPs and refugees who return to their permanent place of residence, were, in fact in occupation of a house or property before the conflict, which now remain damaged or destroyed. Most of the owners of these houses have been displaced several times and do not have any savings to rebuild or repair these houses and business premises. In order to encourage the return of the IDPs and refugees to their permanent residences and ensure a dignified living, the authorities must pay adequate compensation to reconstruct or repair their houses and premises for them to reside and / or engage their business or profession.

In some instances apart from houses entire villages had been destroyed. For the persons who lived in the village mere

compensation will not be sufficient. An example is the Mahilanthanai village at Punani in the Eastern Province. This village was completely destroyed in 1922. The residents of this village are still living in refugee camps. In this type of large scale destruction and where the people are poor and cannot contribute financially or otherwise for the reconstruction of their houses and the establishment of other common community facilities, a housing scheme with the necessary facilities has to be implemented by the authorities.

If housing issues of the IDPs and refugees are not settled, the return of a large number of IDPs and refugees from other districts and from India may cause a social problem in the conflict affected areas.

The IDPs and Refugees are, in some instances, facing difficulties in establishing ownership of their property in order to claim compensation or to raise a loan, as their documents are either lost or destroyed. To overcome this difficulty a system to accommodate secondary evidence to identify the owner, for the purpose of granting compensation, material assistance and/or loan should be adopted.

Another major problem faced by the IDPs and refugees is the illegal appropriation or occupation of their properties by unauthorized persons.

The unauthorized persons occupying such properties are of different categories. They themselves may be IDPs or person who were placed in possession by an armed group or political group. These persons claim that they have no place to go as their own houses are in high security zones or partly or completely damaged. Some of the unauthorized occupants claim that the house and property was given to them by a political or armed group as they do not have a house or property to reside. In addition a fair number of houses are being occupied by armed forces outside the High security Zones.

Different scenarios are present in different instances :

If the owner makes a claim to his property and if a dispute arises the provisions of the Primary Procedure Act may be invoked.

In terms of section 68 of this Act any person, who has been in possession of a property for 2 months preceding the application to court or has been

dispossessed within two months, is entitled to possession. Even a trespasser can benefit from this provision until the owner vindicates his title in the civil court and ejects the occupant in a reivindicatio action. But an action in a civil court is likely to take 2 to 5 years and as there is provision for appeals to appellate courts the final determination of these cases may take about 8 to 10 years.

The owner may even fail in a reivindicatio action because of the existing law of prescription. A few hundred so-called "prescription deeds" (deed of declaration of occupation over the prescriptive period) have already been executed by unauthorized persons claiming ownership of properties occupied by them.

The primary issue in such situations is the applicability of section 3 of the Prescription Ordinance, under which proof of undisturbed and uninterrupted possession for a period of 10 years without acknowledgment of (the Plaintiffs) ownership entitles the occupier (Defendant) to obtain a decree of court granting him title by prescription. Section 13 lists the disabilities, which would delay the

commencement of the period of 10 years. The list refers only to : Infancy, idiocy, unsoundness of mind, lunacy and absence beyond the seas.

The above exceptions will benefit only a refugee who lived abroad. On the other hand, if the owner was internally displaced, he will not be able to obtain judgment in his favour as this situation is not an exception listed in section 13. Even evidence of non- functioning of courts may not affect the running of 10 years. Although there is a possibility that the owner may be able to challenge the claim of prescription on the basis that there was no "adverse possession"" as required by law, it will involve a lengthy legal battle and the success will depend on the merits of each case. Therefore the operation of section 3 of the Prescription Ordinance should be made inapplicable to the affected areas, or the exceptions listed in section 13 should be expanded to include the conflict.

These disputes have to be solved in a just equitable, effective and timely manner meeting out justice to all persons concerned or affected. Shelter is a fundamental requirement and a basic necessity of every person; therefore when considering accommodation and

shelter of the IDPs and refugees, regard must also be had to those of the unauthorized persons who have been occupying these houses and properties for a substantial period of time. The judges could only grant relief or redress according to law. In this instance the courts cannot grant any relief to an unauthorized occupant although the situation demands a just and equitable solution for both affected parties. Therefore an alternate dispute resolution mechanism should be created to resolve these problems with the authority to recommend compensation and alternative accommodation to the occupants in appropriated cases . As there were no housing schemes implemented for the last two decades in the conflict affected areas, it is time to implement such schemes to give accommodation to the unauthorized occupants of these houses and pave the way for the owners to regain their houses. This is not a new concept. There are provisions even in the Rent Act to provide alternate accommodation to the tenant, by the NHDA, when a court makes an order for the ejectment of a tenant.

The IDPs and refugees who were occupying state lands, on permit issued

by the government or without any authority, are, in most cases unable to return to the same lands as the lands are now occupied by unauthorized persons. In some cases the unauthorized person who was in occupation has developed the land. The legal position is to remove the secondary occupant and to give the land to the original permit holder. In that event the persons who have made improvements to the property will not get any relief and will have no remedy. In other instances the permit holder himself will not be able to regain possession as he has not fulfilled the condition of the permit and it would have been cancelled. In those circumstances compensation and allotting of alternate land should be considered to the affected persons. In certain other cases the grant holder had become an IDP or refugee and unauthorized persons are occupying lands given on grant. Even if the IDP is willing to transfer the land which was given to him on grant to the unauthorized occupant it is prohibited by the condition stipulated in the grant. Therefore the person who has a legal title is unable to occupy the land and the person who is in occupation does not have legal title and thus both parties are affected.

It is anticipated that there many be instances where the successors of the

permit holder, due to displacement, may not have succeeded the property as this provided by the land and development Ordinance. Therefore, by operation of law, this land would have been vested with the State. In these instances administrative remedy may be granted by way of providing the same land or alternative land to successor. The provision of land Development Ordinance is that in the absence of a nomination of a successor, the land should devolve to the eldest son of the family after the death of the permit holder. This provision appears to be discriminatory in the present context. Once the land is developed by the father it is just and equitable for all the children to get equal shares of the land after the death of the permit holder.

The use and occupation of the house and property for the IDPs and refugees is prevented in certain cases as the properties are vulnerable to land mines and Unexploded Ordinance (UXO). It is estimated that most of the country's 25,000 land mines are concentrated in the Jaffna peninsula alone. Non governmental organizations and trained persons are involved in clearing these mines. The IDPs and refugees are concerned with their safety even after an assurance is

given that the mines are cleared from their lands, as there is a potential risk in occupying a mine cleared property. Steps should be taken to implement an insurance against any possible death or injury that could occur from the occupation of a mine cleared property.

The other major problem encountered by IDPs is the loss or destruction of the title deeds and other related documents, of their property. The displacements of persons were unexpected. Therefore they were unable to secure their documents. The notaries themselves have got displaced or are dead and the protocols of these documents are lost. The duplicates of the deeds, land volumes or registers and other documents in the land registry in the districts of Jaffna, Kilinochchi and Mullaithivu are, in most cases either destroyed or lost and are not available. This makes it difficult to establish ownership in cases where they are not available. This makes it difficult to establish ownership in cases where the IDP is claiming his property from a person who is in unauthorized possession or in cases where a testamentary case has to be filed to succeed the property or even for the claim of compensation.

The present practice is to write declaratory deed but they cannot be

registered in the relevant folios or connected to the correct folios in the land registry as the relevant folios are not known or the folios are destroyed. Therefore title reports for these deeds cannot be obtained.

In the event of the Land Registry Folios are unavailable the Registrar General should re - construct the folio in terms of the provisions set out in the *Land Registers (Reconstructed Folios)* Ordinance.

The death property owners during the conflict period had caused problem to the heirs in obtaining the death certificate. Some persons are in the missing list and in these instances the succession to property has become an issue. The heirs are not in a position to institute testamentary proceedings. There are a large number of orphans who are in orphanages and welfare centres whose parents would have owned properties but they may not have any proper documentation or be even aware of their ownership or succession thereto. Steps should be taken for the amendment of Births and Death ordinance for the issuance of death certificates in cases where a person's whereabouts are not known. This could also be accomplished

by re - enacting the registration of Deaths (Temporary Provisions) Act, No 2 of 1995. Investigation has to be done in relation to the properties of the orphan children and it should be documented.

In most of the war affected areas the property boundary lines have been destroyed or removed during the war by various causes including the building of earthen bunds by the army for security zones. The persons who remained in the lands also have encroached into the IDP's land. in the Northern province, about 70% of the land has not been surveyed. The deeds are being issued on the basis of a less specific description of the land. Relocating boundaries in case of a dispute may therefore prove difficult. In the absence of records to identify boundary lines and due to high cost involved in surveying the land, the boundary disputes have become a problem for IDPs and refugees. The IDPs have also lost the essential rights attached to the land. As a result of displacement for a considerable period of time and daubing to the change of landscape and due to conflicting claims the IDPs are encountering difficulties in finding their roadway, accesses, watercourses or common wells. There are provisions law to resolve these disputes. But as observed

earlier there will be inordinate delays in obtaining the relief. Therefore an alternative dispute resolution mechanism is best to settle these disputes.

It is a common feature in the northern and eastern provinces that the people earn a living from interest by lending money. They have in some cases lent sums of money to persons on the security of the transfer of property of the borrower in favour of the lender, on condition that the borrower will repurchase the property within a stipulated period after paying the capital and interest commonly called "Conditional Transfer". In these cases the displaced borrower could not have repurchased the land within the stipulated period and the lender will now be the absolute owner of the properties so transferred.

In other cases the borrower had obtained the money on a mortgagee bond with a house or property as security. Due to displaced and not redeemed his property within the stipulated period and now the interest would have accrued and exceed the capital. In these instances the mortgagee who is relying on the interest for his livelihood will not get any of the accrued interest in excess of the capital.

Therefore steps should be taken to suspend the operation of the relevant provisions of the money Lending Ordinance in the lending institutions which are not redeemed by the mortgagors due to displacement and loss of earning as a result of war, the interests in most such cases have exceeded the capital and the Banks and Institutions could recover interest above the value of the capital by special provisions of the law. By these provisions the capital and interest have in some cases exceeded the total value of the property. Hence the mortgagor will be losing his property unless the special provisions are suspended. Therefore the operation of the *Recovery of Loans by Banks (Special Provisions) Act and the Debt Recovery (Special Provision) Act* should be suspended for the duration of the conflict.

There are cases where the owners have refused to handover the houses or business premises to the tenants who were displaced while the tenancy or lease agreement was in force. This situation prevails specially in long term leases. The proof of tenancy will not be difficult if there is a written document available. The landlord may also claim the tenancy or lease hold right is lost due to the abandonment of property. He may also

claim that the property is damaged and therefore the corpus is different. Hence these disputes have to be resolved in a way that is just and equitable to both parties.

The courts in the Northern Province, except Vavuniya and Mannar were not functioning for over ten years and commenced functioning after 1996. The courts in the Eastern Province were functioning except on days there were violence or other disturbances in the vicinity of the court houses. The displacement of the persons and the non functioning of these courts have aggravated the property disputes. On the other hand the Law protects a person who is vigilant but the IDPs and refugees could not have been vigilant about their property rights as they had moved away for safety. Now these property issues have become complex due to the application of the laws that are applicable in normal circumstances. In a property dispute where there is a breach of peace the Primary Courts Procedure could be invoked but it will always favour the maintaining of the status quo. Therefore the IDPs will never get an order in their favour. Similarly the *Prescription Ordinance* prescribes different periods within which one has to claim their rights

if not, the person who is enjoying their rights will become the beneficiary.

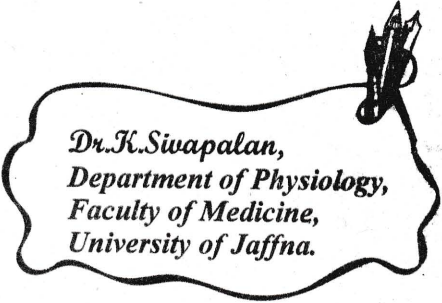
There may be solutions to the disputes of this nature, in some instances if a case is instituted in the appropriate court. But the procedure to resolve the dispute will take several years as there are appeal provisions for each order that is made by the courts of the first instance. It should be borne in mind that the affected persons

are not merely seeking solutions but also timely, just and equitable redress and relief. At this juncture "Equity" demands that we must on one hand safeguard the rights of the persons who are entitled to the property and on the other hand equally ensure that the interests of any other person who had enjoyed and exercised those right for a substantial period of time are not adversely affected.

Environmental Sanitation - An Experience at Mallavi

Introduction

Access to sanitation facilities is a basic human right that safeguards health and human dignity. By the end of the 20th century, 2.9 billion people still did not have this access and were not consistently carrying out essential hygiene practices. This situation affects the poor in particular and has strong negative impact on women and children. Yet, sanitation continues to be the weak partner in the drinking water and sanitation sector. The challenge is therefore to change this situation by moving sanitation centre stage on the development agenda (1)



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One of the deadliest childhood diseases in the world is diarrhoea (2). Most of the communicable diseases, diarrhoea, amoebic and bacillary dysentery, intestinal worms, tuberculosis, typhoid, Malaria etc. spread due to bad environmental sanitation. All these worsen the condition among already debilitated people, especially mothers and children, malnourished due

to displacement and lack of job opportunities.

Environmental sanitation is the key to development not only by preventing spread of disease. The environment has serious impact on the mental and physical development of the children. It therefore is very important to create good environment. Even if we cannot afford to create ideal environmental conditions, at least, we should keep the environment clean with available facilities.

Health program should receive acceptance and support, achieve the desired objective with minimum expenses, and link its efforts with those of other health and socioeconomic development programs(3). This principle applies especially to environmental sanitation. The over - all problem appears not to be a lack of medical know how, but rather a lack of resolve by officers concerned to remove bureaucratic controls and free local communities to take more responsibility for their own health. This paper deals with the experience of achieving this by open discussions and coordination and cooperation of the people and officers in Mallavi.

The Problem:

Mallavi was the most populated and centre area in the west of Mullaitivu district comprising AGA divisions of Thunukai and Manthai East which had a population of about 65,000 during the year 2000.

The centre of Mallavi, where the bazaar is located, was infested with flies and unbearably foul smelling. Investigation revealed several reasons for this:

- *A gravel quarry had been created at the centre of the town long ago. It was decided to fill the quarry by the garbage of the area and to cover it with earth. It was the responsibility of the Prathesia Saba. There was no coordination between garbage disposal and filling by the earth. The waste was being discarded into all over the quarry and effective covering with earth was not possible.

- *There were no latrines in the area except in a few houses and the Hospital. Even the latrines in the market were broken and not repaired. Building new ones or repairing the damaged ones was not possible because the displaced people were poor and building material was not

permitted through the check points. The Prathesia Saba had no funds to do anything. Therefore the quarry was used by the people as an open toilet.

- *The most popular ice cream plus food shop of the area (Seran Suviaham) was situated next to this quarry and was discharging a lot of waste water into this quarry resulting in fermentation of the garbage
- *The market was situated opposite the quarry. All wastes from the market-fish, meat, birds, vegetables, and fruits-were dumped in the quarry haphazardly.
- *Fish carrier boxes were washed around the well in the market and the water stagnated near the well because the soakage pit was damaged and not repaired. Coconut husks were left alone in large piles in the same area in the stagnated water.
- *The slaughter house was about 400 meters away and the contents of the rumen were discarded all around.
- *The animal wastes were disposed less than a kilometre away on the banks of Mallavi Tank. Dogs had free access to this and often bring pieces of rotten meat and bones into residential area.
- *An influential person was claiming that the land of the quarry belonged to him and was blocking all attempts to fence the area by the Prathesia Saba.

Action taken before:

The people of the area were in a state of hopelessness because they have written to all authorities, the MOH, AGA and Prathesia Saba in the past. The MOH has written to the AGA and the Prathesia Saba. The AGA had instructed the Prathesia Saba to do the needful. The Prathesia Saba had 4 labourers who claim to be working to their capacity. No new recruitment was permitted. No funds were available to construct latrines or deposit more earth to cover the garbage.

First attempt to solve the problem :

After studying the situation, we (MOH office) discussed the problem with the officer in charge of the Tamil Eelam Health Service (TEHS) and decided to organize a meeting with all government and LTTE officers concerned along with other interested participants in January 2000. The AGA, The Assistant Commissioner of the Local Council, Officers From the Prathesia Saba, PHI and the MOH participated from the government side. The OIC TEHS, PHI TEHS, Area Leader of the Political Wing, Finance officer of the area, and the Administrative Service Officer of the Area participated from the LTTE side. The local Police Officer, Market Contractor, President and

Secretary of the Mallavi Traders Association, the Manager of the Seran Suviaham, The Manager of the Slaughter house and well wishers also participated. There was no difficulty in explaining the need to improve the sanitation of the area. Everyboby was concerned about the unhealthy situation. It was very constructive Meeting and several decisions were taken:

1. The Prathesia Saba and the LTTE administrative service will negotiate with the encroacher of the quarry and erect fence around it so that disposal of garbage could be regulated through the gate and defecation could be prevented.
2. The Prathesia Saba will clean the market well before end of February and the PHI will chlorinate it thereafter.
3. Washing fish boxes and motorcycles around the well will be prohibited. They will be instructed to carry water to a distant spot and wash. The soakage pit will be repaired by combined effect of Prathesia Saba and LTTE administrative service.
4. The meat stall in the market will be shifted to another location within the market because it was situated at that time within 50 feet from the latrine. The finance officer of the LTTE and the market contractor agreed to do this.
5. Turtles and birds will not be slaughtered in the vicinity of the market. Only meat prepared at other places will be brought and sold. The market contractor will ensure it.
6. Fish and bird vendors will get together and arrange for proper disposal of their wastes. They could pool money and appoint one person to bury these wastes in the quarry. Big fish will be cut by all vendors in a designated place to avoid spreading waste all over.
7. Slaughter house will be kept clean and the animal wastes will be properly disposed in pits dug in the jungle and dogs will not have access to them. PHI from MOH and TEHS will jointly inspect these activities.
8. The Mallavi Traders Association agreed to place half barrels (empty kerosene barrels cut into two) along the main road. The labourers of Prathesia Saba will collect the waste in it.
9. The quarry will be fenced with barbed wire and defecation in it will be prohibited by Prathesia Saba and LTTE administrative service.
10. The garbage will be deposited in designated places by the labourers and the Parathesia Saba will cover it with earth regularly.
11. Seran Suviaham will try to contain the waste water in their soakage pit. If it is

not possible, they will lay pipeline to direct the water further into the quarry and ensure proper soakage without pooling.

It was a lengthy meeting and at the end every body left with a hope that the situation will improve. Every body said that things will change soon but nothing really changed after one year. Every time we approached and reminded about agreed action everybody had some excuse that something is lacking.

Final attempt:

After one year of running up and down, we decided to call for another meeting of all those who participated in the previous meeting. Every body agreed to all the previous decisions and promised to complete their part as usual. At the end we decided to have monthly review meetings to monitor the progress.

At the subsequent meeting every body was embarrassed because nothing had been achieved. But the discussion was different. When the decisions were analysed one by one, concerned parties came out with their difficulties. Alternate courses of action were planned and practicable methods were suggested.

This started to yield results one by one. After four months and four meetings, we have achieved the following.

- * Main obstruction was found to be the labourers. They could always escape supervisors because they could easily find an excuse. Often their excuse was that the LTTE leaders have requested them to do this or that job. Because only four labourers worked and they had to clean Mallavi market, Thunukai market, and the respective bazaar areas they could claim to be working everywhere and not work anywhere. Their bluff was exposed at these meetings and they were placed on no pay for absenting themselves without permission. They were placed under multiple supervision: the PHIs of government and LTTE service, market contractor, technical of the Prathesia Saba, Finance section and Administrative service of the LTTE. This arrangement finally made them work.
- * The Mallavi Traders Association, after repeated pressure, found money and time to prepare the half barrels and placed one for every four shops. This reduced sweeping work for the labourers. They were emptied regularly and deposited at predetermined places in the quarry.

- * The Prathesia Saba changed its practice of putting 6 tractor loads twice a year to one load every month. This provided less exposure of the garbage and better covering by the earth. The PHI was informed of the date for unloading the earth and he will ensure that the garbage deposited till then is properly covered by the earth.
- * A compromise has been reached with the encroacher and the quarry was fenced with gates for access. The market cycle park was shifted to the recovered portion of the quarry and it provided additional protection.
- * The local police agreed to patrol the area during the early hours of the morning in order to prevent defecation in the quarry and the people were forced to construct their own toilets or go deep into jungle area to answer the call of nature.
- * Fish and bird vendors united to contribute to employ one person who will dig a large pit at the centre of the quarry and deposit all their wastes. It was agreed that Seran Suviaham which also has a bakery, will provide ash to cover the waste in the pit everyday.
- * The well has been cleaned and maintained properly.
- * Coconut husks have been removed from the market
- * Fish market has been reorganised so that it could be kept clean. A small shed was allocated for cutting fish.
- * The meat stall has been reconstructed with locally available materials but meeting the requirements reasonably well.
- * The slaughter house has been secured and maintained well. A large pit has been dug at the site of animal waste disposal and all wastes dumped into it. Dogs, if they jumped in, could not come out.
- * Steps were being taken to construct public toilets in the market with funds from TRO and other NGO if government funds could not be found.

All these were possible in four months because of regular meetings where problems were discussed openly. Many alternative and cost effective methods with available resources could be identified due to this multi- sectoral meeting and active participation.

Discussion :

Suggestion by the IRC is presented to complete the picture (1)

Sector professionals around the world face obstacles in their sanitation programmes that are similar in nature, although the solutions are often specific to the situation. There is a need for

concerted effort to facilitate sanitation programming through.

- * Creation of political commitment and development of sanitation policies;
- * Integration of sanitation in water, health or water resource management strategies;
- * Institutional commitment and capacity to address sanitation issues;
- * Reliable low - cost technologies, including an approach for eco sanitation;
- * effective involvement of the private sector;

- * Mobilizations, communication and social marketing, based on existing socio-cultural beliefs and conditions influencing behaviour and attitudes towards sanitation;
- * Appropriate community and user organization through capacity building;
- * Promotion/continuing education for use of facilities and consistent hygiene behaviour;
- * School based sanitation and hygiene education programmes.

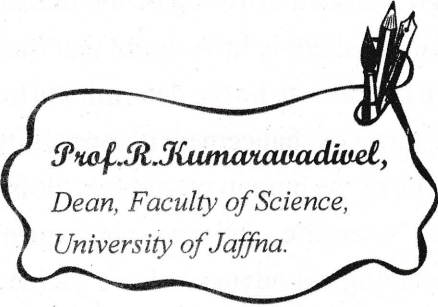
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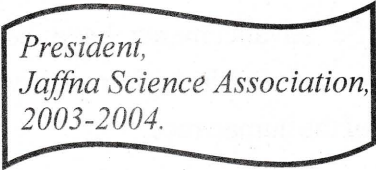
Science and Peace - The Challenges ahead

1. Introduction

We live in an era in which our continued existence in this planet is in question more than ever before. The threat to our existence is not from any alien creature from another world, but from Man himself. The very fact that Man himself is the utmost threat to his fellow beings is the worst facet that endangers the concept and practice of what we call humanism or humanity.



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Man, the well-developed species of all living beings, is perhaps the only creature in the living world that is greedy for position, power and wealth. This greed or endless desire is basic to human nature. At individual level the desire is to possess things that are considered valuable (gold, silver, diamond, vehicles, lands and properties etc). Because of this greed man is also the only creature in the living world that kills members of his own kind. No horse kills another

horse; No dog kills another dog. All other creatures - if they kill - they do so only for food and in defence of their young. Human conflicts arise out of the baser emotions of mankind like greed for power, wealth and position, the quest for revenge and the desire to expand territorial boundaries. Such conflicts which endanger peace range from local skirmishes to war between nations.

It may not be correct to identify this threat by humans to his own fellow human beings with any single group belonging to any specific ideology, race, religion, language, creed etc. It is something inherent in human nature and is commonly found more or less in every human being in some form or the other. But it is when this threat becomes collective - ie. when it is nurtured for a specific purpose - and assisted by destructive elements - the seeds of conflict that are ingrained in human nature start to germinate and the threat turns into a warfare. Some of the most destructive elements that can cause mass destruction are based on some

scientific discoveries and the technologies that followed.

While this is an obvious fact it may seem inappropriate to mention this fact in a seminar with 'Peace through Science' as its theme.

Scientific and technological advances have been the basis for the high standard of living of the human race and there is little doubt that they will continue to be the determiners for the further enhancement of the quality of life of the human race in this globe. The scientific and the consequent technological advances have yielded unprecedented benefits to the human race in areas such as public health, agriculture, housing, transportation, communications, education, industrial productivity, leisure, entertainment etc. On the whole scientific advancements have been the sole cause for the higher quality of living of the human race.

On the contrary, the misuse of scientific discoveries for military and political ends has created world-wide

fear and a sense of insecurity. This has surely been one of the main concerns that reign in the minds of many at present. This concern has, unfortunately, turned some people to blame scientists and scientific and technological advances for the threats faced by the human race. It is a natural tendency for people to look at only the evil aspects of anything, including science. But one should not fail to appreciate the fact that our life in this globe will be worse if search for scientific and technological solutions to our problems is resisted. Abandoning science with all its advantages to get rid of some of the problem arising from its misuse cannot be a solution of the problem.

While the scientific community alone should not be held responsible for the problems or the undesirable exploitations of technological advancements, it must also be stressed that the Science and Technology community should take a greater responsibility for reducing and/or eradicating these problems. Moreover it is the scientific

community that could find viable solutions to these problems.

2.Science, Scientists and Scientific Research:

Science is not a new thing; it had its origin in the remote past. It is a part of the continuous history of mankind from ancient times. Scientists are interested primarily in the discovery and pursuit of Truth, while technologists are interested in the application of those discoveries. Scientific method consists in examining the facts of nature by observation and experiment, in drawing rational inferences from them and then correlating them so as to form general laws. Science has faith in the intrinsic unity of nature, and its aim is to discover all-prevalent laws.

Scientific discoveries have been applied to promote human happiness and welfare. Science has undoubtedly great potentialities and has proved of great service to mankind, as in food production,

nutrition, the cure and prevention of disease, healthier conditions of work, leisure and entertainment, industrial production, the production of power, engineering, rapid means of transport and communication and so on.

But scientific discoveries have also been applied for destructive purposes in society. Because of the destructive use of science, now and then voices are raised against science. It is not realised that science itself cannot be blamed for this; It is the political and military applications of scientific discoveries that have to be blamed.

It is meaningless to demand that nuclear energy should not be developed, lest its products be used in atomic warfare or they will have harmful radiation effects. Likewise it is senseless to argue that research in Microbiology should be stopped for fear of biological warfare, that public health should not be advanced because it will lead to overpopulation and famine, or that communications should not be improved because they

allow the spread of propaganda and disorder. Research and its applications should certainly continue.

Scientists have always raised their voices against the destructive uses of scientific discoveries. It was the scientists, not the non-scientific men, who protested against the use of the atom bomb on Hiroshima and Nagasaki before the Japanese had been warned. In a declaration in the mid-fifties, signed by Lord Russell, Einstein and some other distinguished scientists appealed to all scientists of the world and the general public to subscribe to the following resolutions:

“In view of the fact that in any future World War nuclear weapons will certainly be employed and that such weapons threaten the continued existence of mankind, we urge the governments of the world to realize and to acknowledge publicly that their purposes cannot be furthered by a World War, and, we urge them consequently to find peaceful means

for the settlement of all matters of dispute between them.”

Science alone is not, and can never be, a remedy for all the ills with which humanity is afflicted. A great responsibility rests on those who wield power, for they can by their influence make either good or bad use of the science. Only moral considerations can control the application of scientific discoveries and it is necessary that such moral values are inculcated among the people through sound education and religious practice. It would be too much to expect the scientists and the technologists alone to provide such moral and ethical control. Of course the scientists should assert themselves and, as far as possible, allow their discoveries to be used only for good purposes.

3. Internal and International Conflicts:

As has been mentioned before conflicts which endanger peace range from local skirmishes to war

between nations. The local skirmishes flare up due to poverty, unemployment, economic disparity and social inequality. Internal conflicts (internal or civil wars) such as the ethnic war in Sri Lanka flare up when certain section or sections of the people in a country are subjected to discrimination on language, religious or caste basis and denied equal opportunity in job, education etc. Greed to add territory, desire to have control over natural resources (wealth) of other countries and mutual suspicion are the causes of conflicts between nations.

3.1. Internal Conflicts:

Internal conflicts such as that in Sri Lanka could be easily solved by well planned scientific development coupled with appropriate political power-sharing and constitutional guarantees. Scientific development can heal the nation. Development of infrastructure facilities such as transport, communication and public health, power supply, industries and education - the real fruits of the advancement of Science if they are

implemented with the welfare and economic elevation of the people as the only objective and without political or personal considerations, then all sections of the people will prosper. The people will be happy and contented and an environment will be created where class differences will disappear, good deeds will be promoted and people will come to respect the fundamental rights and freedom of one another. As a consequence there will only be a healthy competition among the people to further enhance their standard of living. Thus peace could be achieved through planned scientific development coupled with sound moral education.

3.2. International Conflicts:

International conflicts results from a desire to control wealth and influence and due to mutual mistrust, incompatible ideologies etc that prevails among some nations. Some of these countries exploit scientific discoveries to achieve their political and military ends causing

unimaginable damages to life and property. Are there ways and means of escaping from this menace ? Before answering this question, let me highlight some of the technologies that will threaten peace, if any country attempt to use them to achieve their political and military ends.

3.3. New Technologies and the threat to Peace:

Of all the challenges that have resulted from scientific advancements, the two that have received most attention recently are those involving advancements in Nuclear Technology and Biotechnology. Research in a new technology the so-called nano-technology is galloping forward. This technology is expected to become commercially viable by year 2020. These technologies can play a major role in the formulation of military strategies that can be very much devastating to an extent that threatens the very existence of Man in the world.

The nuclear energy, a very powerful source of energy, can certainly meet the everlasting demand of energy. It has also shown its capability in fields such as medicine, agriculture and industry improving them substantially. But the matter that really concerns mankind is the possibility of nuclear accidents and its use in warfare. The world has already witnessed the terror it has created, way back in 1945 in the atomic bomb blast and the nuclear accident at Chernobyl in April 1986.

The advent of biotechnology created great enthusiasm among scientists because of its capability in minimising food demands. The modern biotechnology includes a wide range of techniques, which involve the use, and manipulation of living organisms and which can be commercially exploited. Biotechnology is a wider field than what is known as genetic engineering, as it refers to a variety of techniques involving living organisms as a means of production.

The most important consequence the recent advancement in the field of biotechnology has brought is the increasing tendency that its negative aspect may be used even more effectively in future warfare. Biological weapons are easier to use and are doubly dangerous than nuclear weapons. Biological warfare becomes possible through spreading of disease in the enemy camp or country and by affecting the agricultural prospects of the enemy country, which means affecting their livelihood and thus lessening their resistance or by totally bringing it to the zero level.

Nano-technology is expected to provide the foundation of all technologies in the new century. Nano-tech is a way of using atoms in a more efficient way so that they can be used in making more desirable, effective, sophisticated instruments. Nano technology is expected to bring out many benefits in many fields that are directly in touch with the daily life of human beings- an end to disease,

the eradication of air and water pollution, the end of hunger (and agriculture?) through nano- food production, reversing the ageing process etc. But the capabilities of it in warfare are far more dangerous. It could absolutely turn anything, living or non-living, against human beings bringing unimaginable and drastic effects, a billion times larger than the nuclear weapons.

4. Is there a way out ?

New technologies no doubt will emerge in heaps and bounds in the future. We have to welcome these technologies with the right enthusiasm that it needs to have as we have always done. At the same time we have to be conscious of the potential damages they may cause.

Pat Roy Mooney in his book **'The ETC century': Erosion, technological transformation, Corporate Concentration in the 21st century** outlines the means through which these two aspects can be handled. In a model international

convention that he has proposed in this book for the Evaluation of New Technologies, he spells out three basic points, which should lead governments to negotiate a technology convention:

1. The earlier a technology is evaluated the more likely the evaluation is to be free of distortions.
2. The earlier the evaluation the less likely acceptable technologies are to be slowed down or halted when they are being made ready for public use meaning fewer costs and risks for the proponents and beneficiaries.
3. There is a need for an international convention. There are powerful new technologies (*for example nano technology*) on the horizon-and many more over the horizon-that they could match or exceed the impact of biotechnology.

Having said this Mooney out the necessary elements that need to be a part of the proposed convention:

1. Put in place accessible and transparent mechanisms capable of identifying potentially significant new technologies that require evaluation under the terms of the convention.
2. Determine the benchmark studies and development signposts necessary to allow evaluation of the technology and to track its evolution.
3. Ensure the full and effective participation of all sectors of society in the evaluation:
 - especially those identified by its developers as likely to be exposed (positively or negatively) to the technology
 - but also including all social sectors customarily excluded of such as the poor, women, disability associations, indigenous people, labour, consumers, and public sector scientists.
4. Establish accessible and transparent consultative processes and time tables for the evaluation of each technology.
5. Through fact-finding and consultative processes, set the terms and conditions under which a new technology might be introduced into society and the environment and the terms and conditions under which the technology might be recalled if later found threatening.
6. Monitor the impact of a new technology following its introduction.

Such a convention, Mooney says, should be legally binding so that it has an overall effect internationally. It is also important that the convention should be flexible enough so that it can be revised according to the situations and needs that may rise in the future.

An International Convention along the lines proposed by Mooney may prove to be a milestone in controlling the use of scientific discoveries and new technologies from annihilation of the humans from this beautiful world.

5. Conclusion:

The internal conflicts within a country could be solved and peace made to blossom through planned scientific development coupled with sound moral education.

The threat to world peace can be avoided only if the differences among nations are resolved by peaceful means and if goodwill is cultivated between them. To promote goodwill in all sections, a complete change of heart is necessary. Only through the collective efforts of people at different levels not just the

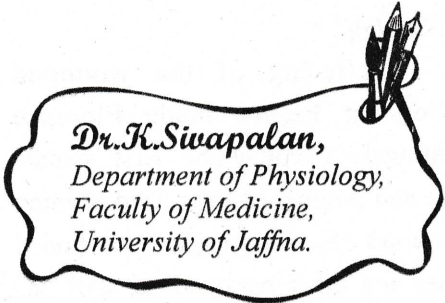
scientists there will be an assurance for peace. I wind up my presentation by quoting from the famous American John Foster Dulles:

“There is no simple formula for peace, and no single act that will assure peace. Any who preach that are dangerously deluded. Only the combined result of many efforts at different levels, and at many places, will assure peace. In these efforts everyone has a part to play. The stakes are the greatest for which men have ever played.”

Health science and peace

1. Introduction.

World Health Organization has defined health as 'complete physical, mental, social and spiritual well being and not merely the absence of disease or deformity'(1).



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Health care developed since time immemorial but it was a slow process. Development of health science had to depend on observations and associations as and when illnesses occur. Creating illnesses in human for research purposes is unethical. It has been the 'Art of Medicine'. But war, unavoidably, created conditions of human suffering. Scientists in the field of health used this opportunity and contributed to advancement of medicine. On one side there were incidental situations of suffering and on the other side prisoners of war have been subjected to all kinds of torture and even used as experimental subjects especially in the concentration camps. The results of these experiments have contributed to better health care systems not only at times of war but also at times of peace.

Here , unfortunately, only a few health personnel remained in the war affected areas and they could hardly find time to provide adequate health care. This has resulted in missing a lot of opportunities for research.

Historians had described the 'Tamil society' to be law abiding, hard working and hospitable (2,3 and 4). The aim of reconstruction , resettlement and rehabilitation of the health system should be restoration of these qualities completely.

2.Health care and science promoted by War.

The field of medicine saw rapid growth during the twentieth century(5) . Two major factors contributed to this advancement: one is the development of technology which permitted advanced research and treatment methods; and the other is the war , two world wars , which provided human subjects for research and created the necessity for better medical care. Some examples are:

2. a. Nutrition:

Famine and various forms of malnutrition seen during the war years

permitted scientists to carry out massive studies in this field(5,6).

2.b. Alimentary physiology:

William Beaumont, an army surgeon, contributed to physiology of stomach because a gun shot injury to the stomach of Alexis St. Martin healed with fistula (5). This provided an opportunity to perform several experiments and study the response of stomach directly.

2.c. Nursing:

Suffering of the wounded soldiers in France made Florence Nightingale become the first female nurse and pioneer of organized training for nurses (5). Introduction of trained nurses and other paramedical staff has revolutionized the health care system.

2.d. Organizations for health care:

War and the suffering have provoked service - minded people to get together and create institutions to care for the suffering people, originally the war affected, and later the vulnerable people. ICRC, OXFAM, MSF are some of the international organizations to mention(5). WHO, one sector of the UN, is one important result of the world war and it is a major health care provider in

the world. All these organizations contribute to physical, mental and social health within their capacity. TRO is one such organization created by the Tamils during our struggle(7).

2.e. *Biological weapons:*

A dangerous area of health research has been into biological weapons. There are people who argued that dangerous weapons of this nature keep delaying the third world war because of fear of the consequences. Interestingly enough, we are witnessing a war in Iraq in the name of destroying chemical and biological weapons.

3. *Disturbance of peace by ill health.*

The world could not sustain peace even though every body preaches about the virtues of peace. If the leaders happen to be mentally abnormal, war or unrest is inevitable. For example, Psychopaths are simply morally depraved individuals who represent the "monsters" in our society (8). Their characteristics are worth noting:

Superficial charm, grandiose self-worth, need for stimulation or proneness to boredom, pathological lying, conning and manipulative, lack of remorse, parasitic lifestyle, poor

behavioural controls, promiscuous sexual behaviour, lack of realistic long term plan, impulsivity, irresponsibility, failure to accept responsibility for own actions, criminal versatility.

Sadists derive pleasure by cruelty to others. Masochists mutilate dead bodies. Megalomaniac leaders claim to possess magical powers, omnipotence, and connection to God. Megalomania is the belief that one is able or entitled to rule the world. Traditional elements of authoritarian personalities include the following(9):

A Sadistic - masochistic tendency, the tendency to hierarchy, the drive for power (and wealth), a one sided scale of values favouring the one in power, hostility, hatred, prejudice, superficial judgement of people and events, interpreting kindness as weakness, the tendency to use people and see others as inferior, incapability of being ultimately satisfied, paranoia.

Journalists often encourage the audience to experience the same traits of insensitivity, sadism and grandiosity, particularly when the journalist suffers these flaws and builds them into his reports. The audience sees the world

through the eyes of journalists. This makes people to mock and take pleasure from, or be insensitive to, the suffering of others.

It is therefore essential to carefully assess the mental state of all persons holding key posts in the government and in journalism if peace is to prevail. The paradox of the war in Sri Lanka is that the leader who is shouldering the struggle of Tamil people is described as megalomaniac (10) but the mental state of the offenders who insisted on refusing the rights of Tamils and carried out armed oppression on the people in this island has never been commented

4. Challenges to health in peace locally

Health services in Tamil areas of Sri Lanka have faced the effects of war over the last two decades by way of destruction and embargo on top of less development since independence. Providing adequate health care is essential for the people to make the best of the peace. Further, the gap between the Tamil areas and the rest of the island has to be bridged.

4.a. Staff and structure.

War torn Northeast of Sri Lanka has suffered heavy damages to the

buildings. On the other hand, no new structure has been built during the past several years. This requires planning to upgrade existing buildings and new ones in place of damaged buildings to match the current situation which is going to need colossal amounts of money.

With regards to staffing, all categories, consultants, doctors, nurses, midwives, preventive health staff, and paramedical staff need to be appointed (11). It is going to be a very difficult task. While aiming at recruiting new staff and establishing training centres for them, lobbying is needed to mobilise the government machinery to overcome the bureaucracy and to absorb the volunteers who, even though without stipulated qualifications, had supported and maintained satisfactory health service during the worst of times.

4.b. Nutrition

Prolonged war and displacement has led to chronic malnutrition which could not be detected by weight for height. Several surveys conducted by different organizations have indicated high prevalence of malnutrition among mothers, children and primary school children (12, 13, 14, and 15). This is going to have serious implications for our

future generation which will be weak and feeble. Immediate measures have to be taken to correct malnutrition at all levels: mothers, pre-school children and primary school children.

Another serious concern is the total lifting of the embargo. All kinds of sweets, biscuits and ice creams have filled all shops consuming them in preference to more nutritious green leaves, dhal, meat etc is the fashion. This food habit is known to result in insulin resistance and will lead to increased incidence of diabetes, hypertension and heart diseases and create a sick society (16). Another concern is the increased risk of dental caries due to the sweets, particularly among children.

4.c. *Physical trauma.*

People with disfigurement due to physical trauma - scars and loss of limbs should be surgically treated. Already we have had a team of plastic surgeons coming from UK on good will mission and treating patients. Programmes for prosthesis may have to be upgraded to provide satisfactory service.

4.d. *Mental trauma*

Prof. D.J. Somasundaram has described in detail about this at the Prof.K.Balasubramaniam Gold Medal

Lecture, in 2002 (17). Main points are summarised here.

Civilians are no longer "incidental casualties"; key element of modern political violence is the creation of terror to penetrate the entire fabric of economic, socio-cultural, and political relations. As a result wide ranging psychological problems are seen in the society.

Psychological problems due to war is widely prevalent in the schools. Malignant Post Traumatic Stress Disorder manifesting with mistrust, smouldering bitterness, resentment, and a thirst for revenge is also seen.

Single parent families experience immense problems resulting from having to earn and look after the family singly. Loss of identity (own village and house and sense of belonging to a community) and livelihood are serious stress factors. Those who have lost family members due to war continue to experience psychological problems.

Faith in social justice is lost. Anti-social personality development in children is observed and it is a known long term consequence of war. Work out

put and social values have declined considerably due to frustration and excessive stress.

It is going to be a difficult task to build the law abiding and hardworking Tamil Society. In addition to resettlement, rehabilitation, and reconstruction, measures like confidence building and counselling individually and collectively at community level will have to be undertaken to bring normal mental state.

4. e. *Family health*

An important strength of the society had been close family ties. This has experienced severe strain due to death, displacement, and poverty. This has caused deterioration in mutual understanding and caring for each other.

The Family health worker, who is expected to visit all pregnant and lactating mothers and children and thereby be familiar with all families in the area in order to maintain their health and provide health education, is apparently confined to immunization and collecting statistics because of lack of staff and over-work for available staff. Increasing incidents of violence against women and children is a serious concern.

A very disturbing report is high maternal mortality rate and lower birth rate in the north east when compared to national figures (18)

If we fail to ensure proper health for mothers and children and regain the family structure, there is no future for our society.

4. f. *Morality and drug abuse*

The psychological trauma, decline in social values, availability of licensed and illegal alcoholic drinks, addictive drugs in plenty and video films provoking sexual perversion and lack of vision for the future have collectively influenced the morality of the society. Isolation or separation from family makes any individual easily vulnerable to drugs, alcohol and sexual promiscuity. This, in addition to affecting the social health and future of our children, has increased the risk of sexually transmitted diseases, particularly that of AIDS (19). This is a vicious circle which can lead to self destruction of our society.

This has to be tackled carefully: on one side, people should be given opportunity to return to "normal" life with adequate health education and on the other side law and order should be

maintained very strictly. Healthy recreational activities such sports, music, drama etc, should be promoted.

The above concerns were not experienced in the LTTE controlled areas where the morale remained high in spite of imminent famine, death and destruction probably because of high expectation among the people and good public relations and policing by the authority. Further, the Tamil Ealam Health Service is carrying out health education programmes with the help of government health services especially observing health week at the time of Thileepan's commemoration.

4. g. *Resettlement*

Peace means resettlement. All those who fled their homes due to effects of war will have to come home. This is not without problems. They have gone far and wide and been exposed the wide variety of cultures, stresses and societies. They and their children are going to come back with acquired culture and diseases. AIDS has been already reported among a few returnees but it did not spread as feared. It will remain a serious risk when large numbers return.

4. h. *Quack doctors and malpractices.*

In a sick society that is confused, in the absence of adequate proper health care, quack doctors and opportunistic practices proliferate and they worsen the situation. Common man is attracted by them because of easy access and low cost. New religious practices and new health systems can be seen to prosper. People fell for a magical mushroom tablet that claimed to prevent all possible illnesses and created several sick people. There is a "pulse Specialist" who claims to offer cure for diabetes and hypertension and several other diseases without any drug. He appears to be a part of group of practitioners who thrive by condemning other established systems of medicine because he is distributing articles supposed to have been written by some Indians (personal encounter). The Sri Lanka Medical Council should evolve adequate measures to deal with such persons. People must be warned about the risk of believing in such practices.

All medical practitioners were monitored for malpractices in LTTE controlled area. Partially qualified practitioners were permitted with specific instructions about their

limitations. A criminal abortionist was arrested in Mullaitivu district and was sentenced death about 3 years ago (personal knowledge).

A dangerous practice that has evolved is to discuss among friends and relatives and use drugs on their advice with no knowledge of dose, antibiotic sensitivity or even the need for antibiotic. This has contributed to the high level of antibiotic resistance especially to dangerous diseases like Typhoid fever (20).

4. i. *Environmental health*

This appears to be a totally neglected field in Jaffna. Historical and cultural perspective of cleanliness among Tamils is not to be seen or at the most limited to front portions of the households only. The environment plays a major role in infectious diseases specially diarrhoea in children. Also it influences mental development of the children. We have to think seriously of coordinating all authorities concerned with management of environment and develop strategies to create good environment.

Attempts are made in LTTE controlled areas to keep the environment clean(21). At least once a year, on the Martyr's Day, every nook and corner of these areas are cleaned up. Deforestation is kept to a minimum and reforestation or at least planting trees where jungle is destroyed is being undertaken.

4. j. *Economy*

Economy has been ruined by the war. It is essential to revive the economy. But, uncontrolled open economy in a debilitated society can only widen the gap between the haves and the have-nots. As long as the poor remain poor, revival of health status is not possible.

In order to revive the economy, agriculturists research and develop cash crops. One such crop is tobacco (22). Research papers and especially popular articles as, "can't we raise the standard of our cigars to international standards (23)" create positive attitudes among public, particularly children, and promote consumption. Further, cultivation, processing, and storage in populated areas force every body to inhale vaporising nicotine. In developed countries, smoking in public places has been made a punishable offence because of the risks involved.

Agriculture should provide good nutrition and good health. We have seen people selling their produce like milk only to purchase bread, toddy, or tobacco. We have to choose between quick money with expenditure and consumption of nutritious food leading to good health.

4. k. *Health research*

As mentioned above, health personnel in the war affected area have hardly any time to do research. However, some researchers have found time to document their observations. Apparently, there is a risk of political or some other factor influencing research. For example, work on a PhD thesis (24) has recorded reduction in alcoholism in Jaffna after the Jaffna Exodus. It is difficult to believe as there is a concern about proliferating licensed and illicit liquor outlets and steep increase in alcohol consumption after Jaffna came under military control. Another plain fact, to support the doubt, is the action taken by the authorities to meet the demand for alcoholic drinks: the shipment of essential supplies like food substances were withheld and alcoholic drinks were loaded in ships bound to Jaffna. Under these circumstances if a research reports reduction in alcoholism,

it is inevitable to suspect manipulation of the results.

All above mentioned and other possible problems have to be studied by academics without bias but with a view to improve the standard of living of our people.

4. *Recommendations to restore health of our people*

Meaningful solution to the struggle

Normalization of life styles

Health education.

Confidence and capacity building

Improve legitimate health care

Improve maternity and child health care

Reduce violence against women and children

Coordinated effort for environmental sanitation

Promote people participation in recreational activities and sports.

Strict enforcement of law and order

Educate people about dangers of indiscriminate use of drugs.

Promote agriculture and fishing for local consumption

Meal for school children

Guarded economic activities

Honesty among academicians and researchers.

Screening for communicable diseases, especially for AIDS

Treatment of scars and prosthesis for needy.

Analyse the mental state of the politicians and journalists.

4. *Conclusion*

When WHO defined health, it also had another ambitious goal : HEALTH FOR ALL BY THE YEAR 2000. We also should aim for same as the saying goes,

"Health is Wealth". If we achieve the state of health, our people will be once again hard working, industrious and hospitable.

Health authorities alone can't achieve this. It has to be a multi disciplinary effort with people's participation. It is time to break the vicious cycle of low social values, poor health and poor economic activities.

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Achieving Peace through Scientific Techniques

Problem Solving

Every problem is different but specific. A problem is a question to which an answer is required but is not immediately apparent. Edward de Bono wrote "By definition a problem is a situation that demands an answer and by implication that answer is not obvious".



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A problem is taken as a state of affairs which is sufficiently unsatisfactory to stimulate some one or some group into taking action. Therefore solving a problem involves the conversion of an unsatisfactory state to a satisfactory one.

All problems need decision to resolve them. Decision making is part of problem solving. Decisions have an interesting quality - they are taken both actively and passively. A manager who ignores persistent lateness from an employee is taking a decision. Lack of a decision is an act of commitment.

Decisions vary greatly in complexity. ranging from the straight forward to the complex. Complexity is

related to the number of decision criteria involved and the significance of the choice made. Decision criteria, the factors which need to be assessed in making a choice between options, can be complex.

TOSIDPAR Method of Problem Solving and Decision Making

(TOSIDPAR - First letters of the following eight steps)

1. Tuning In - Defining the Problem

The first requirement in problem solving is to bring a problem into focus so that it can be given attention. Problems can usually be looked at from several points of view. Ways of defining a problem and assessing its significance are called "framing". Try several frames (i.e. ways of defining the problem) - seeing the situation without jumping to a conclusion.

The sequence of steps needed to work constructively, on a problem is called "the process"

- Finding important issues
- Framing the issues
- Process planning

2. Objective Setting - Deciding the outcomes

Objectives are conceptual tools for focusing human effort and setting targets for achievement.

One of the important stages in objective setting is coping with the fact that interested people have different wants and needs. All the interested groups are stake holders in the problem and objective setting requires comprehensive stake holder analysis.

After the interests of different stakeholders have become visible, it becomes possible to set goals.

- Classifying possible goals
- Stakeholder analysis
- Goal setting

3. Success Measures - Setting Standards

Measurability is a key attribute as it results in objectives becoming truly useful tools. If set realistically, success criteria provide a logical way to determine how much effort should be invested in solving a specific problem.

A measure is a way to evaluate progress and provide feedback. Only measurement feedback provides the data necessary to redefine action in the light of experience.

- defining success
- establishing success criteria
- installing success measures

4. Information Collection - Finding Data

Information can be facts about a situation, deductions, ideas or concepts. Facts provide valid insights into the nature of the problem. Deductions ascribe meaning and build links between facts. Ideas are leaps of imagination on causes of the problem or suggest remedies. Concepts are generalizations which helps us "see the wood from the tree" and render complex situations sufficiently simple to be considered.

Pieces of information tend to be collected in a piecemeal fashion. For example ideas may be generated in a "brain storming" session.

- gathering data and ideas
- clustering information
- developing options

5. Decision Making - Choosing what to do

An informed choice is made after weighing the merits and demerits of options. Objectives and success measures should be considered but there is a need to produce a full and well defined list of criteria:

Intellectual honesty is required to assess each option against all of the

criteria. Emotions distort assessment process. Human factors intervene values. There are no scientific formulas which can replace people's informed judgment when issues concerning human values have to be resolved.

- defining decision criteria
- weighing options
- choosing.

6. Planning - Working out How to Do?

Planning transforms an intention into an actionable sequence of events. Identify tasks which are parts of work that can be understood and could be allocated. Whenever delegation of tasks takes place, these must be effective control. Suitable control mechanisms should be incorporated depending on the range of tasks, communications and coordination measures have to be implemented.

Tasks must be arranged in sequence depending on other tasks leading to a network plan. This scheduling of tasks should take into account the available resources such as machinery, manpower and materials - neither allowing inefficiently to develop nor over stressing the organization to the extent things can no longer be done with quality and care.

- task identification
- selection control principles
- installing coordination mechanisms
- scheduling tasks

7. Action - Making Something Happen

Action is the implementation of plans combined with the energetic and intelligent adaptation to any circumstances that arise. The most uncertain the environment the more those involved must adapt to unexpected situations.

- Implementing plans
- Intelligent adaptation

8. Review to Improve - Evaluation

Within each experience there will be an opportunity to learn and improve. Innovation is a vital element.

By review process, each individual can identify improvement plans which enable his contribution to have greater value. Also groups and organization benefit as broader areas for improvement emerge. Review process transforms inadequate performance into a spur for improvement.

- learning from experience
- identifying personal development plans
- identifying group/organization development plan

Mechanism of Mind and Perception

How do people disagree?

- a) Because they see things differently
- b) Because they want different things.
- c) Because their thinking style encourage them to disagree.

You are seeing things which your mind wants to see.

The first stage of thinking is perception. It is in perception that the external world is translated into symbols or words. These perceptions are then manipulated using the excellent systems of language, logic, mathematics etc. We have developed these systems without understanding or developing the system of perception. That is the whole trouble now. We have developed the car and highway but not the driving. Intelligence is like the car and thinking is like the driving part.

Perception depends on the way the brain works. Perception is very individual and may not correspond with the external world. Perception is the way the brain organizes the information received from the outer world through the senses. The short term memory of the

present context and what has gone immediately before affects perception. Mood is very important.

Perception is like a dream. But it is more real as anything else. In fact perception is more real for the person involved. Perception leads to beliefs and that leads to conflicts. The more you believe, harder it is to resolve conflicts.

In our tradition we have sought to get away from the vagueness and instability of perception in order to deal with such concrete matters as mathematics and logic. We have done reasonably well at this and now get back to dealing with perception as such. Indeed we have no choice because if our perceptions are faulty then perfect processing of these faulty perceptions can only give an answer that is wrong and sometimes dangerous.

We knew from experience that both sides in any war conflict or disagreement always have "logic" on their side. This is true, a logic that serves their particular perceptions.

How do perceptions come about? What is the origin and nature of perceptions? How do the nerve circuits in

the brain form and use perceptions? How do perceptions become stable, and stable enough to become beliefs? Can we get to look at our perceptions regarding any particular matter? Can we change perceptions and if so where do we start?

If we can answer these we can resolve conflicts easily. Our earlier methods of solving conflicts by war or by argument or by negotiation have become useless now. With argument we spend our time attacking existing ideas rather than designing new ones. Bargaining is an improvement on arguing.

With negotiations we work within the boundaries that exist rather than design new ones. Negotiations involve value trading which in turn to compromising values. Problem solving method is better than negotiations.

Problem solving is very straight forward. Identify the cause and remove it and that solves the problem. It has worked well and we have solved many problems in Medicine and Engineering. This works well when the cause is singular. We are still struggling with solutions to problem with more complex behavior such as high blood pressure, heart diseases, cancer etc.

Conflict Resolution

There was a time when family fought family. Then tribe fought tribe. City fought city as in Greece. Then nations became the fighting units. As weapons increased in power, so the units became bigger. As the expense of war increased, only bigger units could afford it. As communication technology improve, cultures and values become more uniform. Now superpower bloc is the next logical progression which would result in large scale destruction. Do we have to proceed through this logical inevitability or can we by pass it?

There is the logic of weapons technology and the logic of armament competition. There is the logic of deterrence. There is tension and hostility and lack of communication. There are crude and primitive ways of handling this through institutions like the United Nations, which is structurally inadequate for the role. There are very old-fashioned concepts and idioms of thinking which work to inflame conflict rather than design a way out of it.

We do have to accept that our method of solving major disputes and conflicts have been crude and primitive, inadequate and expensive, dangerous and destructive. The increasing

complexity of the world and the increasing power of our weaponry, force us to rethink our conflict resolution method. Why is it that our intelligence has locked us into habits, idioms and institutions that prevent a better use of our intelligence?

The reason is that we have developed a thinking system that was appropriate for developing staged but when developed, is dangerously inadequate. That thinking system has served us well in most areas -except in the area of conflict resolution, when it is totally useless. This is because the thinking system (based on language logic and the principle of contradiction) is itself a conflict method. so we apply conflict to the resolution of conflict.

Even if we were to operate traditional methods with the best will in the world and the highest available intelligence, these methods would not suffice. (We have seen this in the Sri Lankan Ethnic war situation). There is a need for a fundamental shift in our thinking approach to the resolution of conflict.

A reappraisal of our esteemed argument / clash type of thinking with its attractions, dangers and limitations has become an urgent necessity. It is unfortunate that the parties most directly

involved in a dispute may be in the worst position to settle the dispute.

There are three roads to conflict resolution: fight/litigate; negotiate/bargain, design a way out. All this time only the first two are available to the disputants. The design road demands a third party that can look at the situation from the third party angle. This introduces the concept of "triangular thinking". This third party is neither judge nor negotiator but a creative designer.

In any dispute the two opposing parties are logically incapable of designing a way out. There is a fundamental need for a third party role. That leads to the concept of "triangular thinking".

Our present structures of governments and the United Nations are structurally inadequate to take on the design role. With the best will in the world, they will remain representative and argument-

ative. There is a clearly defined need for a new organization which will have a "supranational independent thinking" role. Call it S.I.T.O.

It is not suggested to adopt the traditional complainer's role of attacking a system and pointing out its faults, in the hope that corrections of such faults will put things right. There cannot be any hope of that. Changes within the same idiom cannot work. There has to be a change of idiom.

The needed shift is much more fundamental than most people realize. Our thinking systems are desperately old fashioned, on matter with what complacency and pride we hold them. They are totally inadequate for conflict resolution at this developed stage. There need to be a language shift. The design idiom is the practical idiom for conflict thinking and the formulation of an institution as SITO might be a practical supranational structure for conflict thinking.

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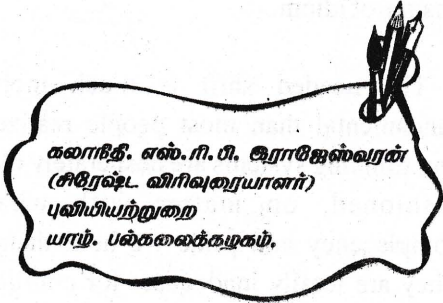
1. "Effective Problem Solving" by Dave Francis. Routledge, London 1989.
2. "Making the Transition from Engineering to Management" by Barry T. Turner. Unpublished notes.
3. "Conflicts - A Better Way to Resolve them" by Edward de Bono Published by Harrap, London 1985.

**இலங்கை மற்றும் "அடம்ஸ்" பாலம் (இராமர் அணை) மீதான
புவிச்சரித வெளியுருவ, நீரியல் சார்ந்த விளைவு நிலை**

(Geo-hydro implication on Adams bridge and Sri Lanka)

முன்னுரை

புவியோட்டின் (earth crust) மேற்பரப்பில் காணப்படும் கண்டங்கள், சமுத்திரங்களின் இன்றைய ஒழுங்கமைப்பு மிக நீண்ட காலமாக இடம் பெற்றுவந்த புவியோட்டசைவுகளினதும் (Crustal movement) மற்றும் வளிமண்டல கட்டமைப்புக்களில் ஏற்பட்டு வந்த மாற்றங்களின் விளைவுகளால் ஏற்பட்டவையாகும். மேலும் இச்செயன்முறைகள் தொடர்ந்தும் இடம் பெற்று வருகின்றன. இதன் காரணமாக புவிமேலோட்டில் பெரும் மாற்றங்கள் நிகழ்ந்து கொண்டிருக்கின்றன. மேலும், இன்று நாம் காணும் நிலப்பரப்புக்களும் நீர்ப்பரப்புக்களும் தொடர்ந்தும் மாற்றமுற்று வருவதனால் பலநூறு மில்லியன் வருடங்களுக்கு முன்னர் புவியோட்டில் நிகழ்ந்திருக்கக் கூடிய நிலவரங்களை அறிந்து கொள்வதும் கடினமாகவுள்ளது. ஒரு குறித்த பிராந்தியமொன்றின் தற்போது காணப்படும் உருவவியற் கோலங்களை, (Morphological pattern) அதன் நீண்டகால புவிச்சரித நிலைமைகள், வெளியுருவ செயற்பாடுகள், வளிமண்டல நிலைமைகள் போன்றவற்றை



கலாநிதி. எஸ்.ரி.பி. இராஜேஸ்வரன்
(சிறேஷ்ட விரிவுரையாளர்)
புவியியற்றுறை
யாழ். பல்கலைக்கழகம்.

அறிந்து கொள்வதனுடாகவே விளங்கிக்கொள்ள முடிகின்றது. அந்த வகையில்தான் இலங்கைத்தீவுடனும் மற்றும் தென்னிந்தியா நிலப்பரப்புடனும் இணைந்துள்ள “அடம்ஸ் பாலம்” என்று அழைக்கப்படுகின்ற புவிவெளியுருவ அமைப்பை அதன் கடந்தகால புவிச்சரித நிலைமைகள், வெளியுருவ செயன்முறைகள், காலநிலை மாற்றங்கள் போன்றவற்றை தொடர்புபடுத்துவதனுடாகவே இன்றைய நிலையை விளங்கிக் கொள்ள முடிகின்றது. மேலோட்டமாக, புவிமேற்பரப்பு அம்சங்களை நோக்குபவர்களுக்கு தென்னிந்திய - இலங்கை நிலப்பரப்புகளுக்கிடையே சாதாரண “நிலப்பாலம்” (Land Bridge) போல தோன்றும் “அடம்ஸ் பாலம்” அல்லது “கிராமர் அணை” இப்பிராந்தியங்களில் நீண்ட காலமாக நிகழ்ந்து வந்திருக்கக்கூடிய புவியுட்பாக, வெளிப்புற செயன்முறைகளின் (Exogenic and Endogenic) விளைவுகளைப் பிரதிபலிப்பதாகவே கொள்ள வேண்டும். எனவே, இப்பிராந்தியங்களில் மிக நீண்ட காலங்களுக்கு முன்பிருந்து இன்றுவரை எவ்வாறான புவியோட்டு அசைவுகள் இடம் பெற்று இருக்கின்றன? அதனால் ஏற்பட்ட விளைவுகள் யாவை? நிகழ்ந்து வந்திருக்கக்கூடிய காலநிலை மாற்றங்கள் எவை? எத்தகைய வெளியுருவ செயன்முறைகள் இடம் பெற்றிருக்கக்கூடும், அதன் காரணமாக ஏற்பட்ட வெளியுருவ நிலைமைகள் எத்தகை

யவை போன்ற அடிப்படை வினாக்களுக்கு விடை காண்பதனுடாக இலங்கை மற்றும் அடம்ஸ் பாலத்தின் மீதான புவிச்சரித, வெளியுருவ நீரியல் சார்ந்த விளைவுகளை வெளிக் கொண்டு வருவதாக இக்கட்டுரை அமைகின்றது.

இலங்கையின் தோற்றம்

பரிணாமத்தோற்றக் கருத்துகள் நிலைபெற்றிருந்த காலத்தில் நிலவுருவங்களும் ஒரு படிமுறை ஒழுங்கில் உருவாகியிருக்க வேண்டும் என்ற கருத்து வலுவுற்றிருந்தது. இலங்கைத் தீவின் புவியியல் அமைப்பை நோக்கிய ஆரம்ப புவிச்சரிதவியலாளர்கள், கடலில் இருந்து இலங்கை படிப்படியாக குத்துயர்ச்சி முறையில் உருப்பெற்றிருக்கின்றது என்று கருதியிருந்தனர். இவர்களுள் “அடம்ஸ்”, “வாடியா” என்பவர்கள் குறிப்பிடத்தக்கவர்கள். (Adams. F.D., 1929, Wadia, D.N., 1945) இவர்களுக்கிடையில் கருத்து வேறுபாடுகள் இருப்பினும் குத்தசைவுகள் மூலம் இலங்கை உருப்பெற்றிருக்கின்றது என்ற விடயத்தில் ஒற்றுமைப்படுகின்றனர். ஆனால் பிற்பட்ட புவியியலாளர்கள் இக்கருத்துக்களுடன் உடன்பாடு கொண்டிருக்கவில்லை. இவர்களின் கருத்துக்கள் புவியோட்டசைவுகள் மூலம் இலங்கையின் பெரும்பகுதி, வேறு ஒரு பெரிய நிலத்தினிவில் இருந்து பிரித்திருக்கின்றது என்பதை ஏற்றுள்ளனர். (Kula-ratnam, K, 1944, 1951; Cooray, P.G., 1967; Senaratne, A and Dissanayake, C.D., 1982).

1960க்கு பின்னர், “கடற் தரைப் பரவுதல்”, “கண்ட நகர்வுக் கோட்பாடுகள் போன்றவற்றின் செல்வாக்குக் காரணமாக இலங்கை - இந்திய புவியோட்டுடன் தொடர்புபட்ட ஆய்வுகள் பல வெளிவந்துள்ளன.

[Curry, J.R. and Moore, D.G., 1974; Crawford, A.R., 1974; Eremenko, N.A., 1968; Crady, M.B., 19781; Mckenzie, D.P. and Scalater, J.G., 1973; Pathirana, H.D.N.C., 1980; Smith and Hallam, A., 1970; Vithanage, P.W., 1972, 1985, 1986.)

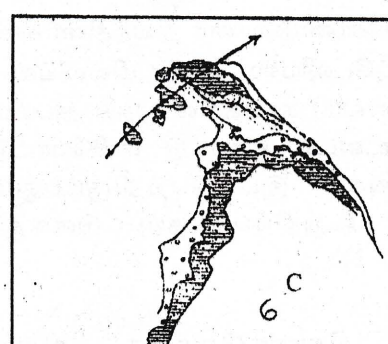
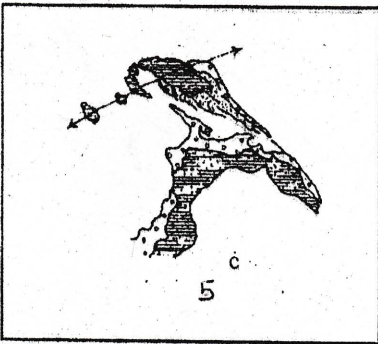
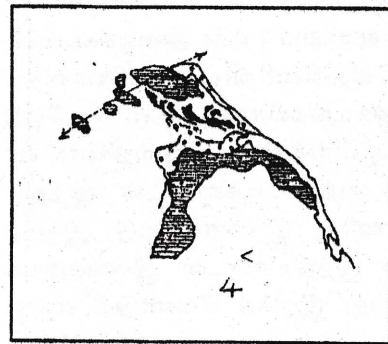
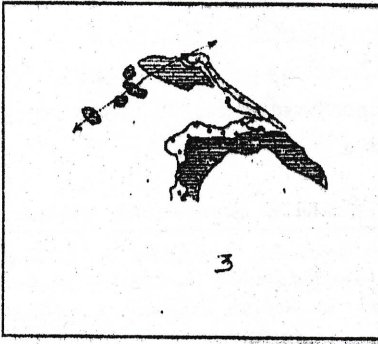
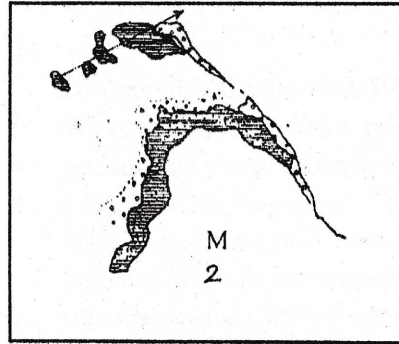
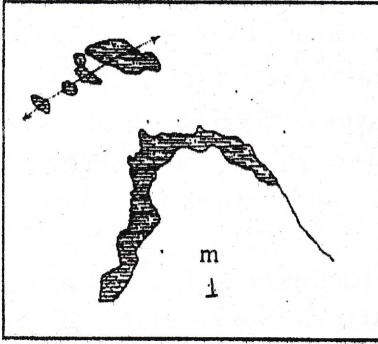
இவற்றின் விளக்கப்படி, இலங்கைத்தீவின் பத்தில் ஒன்பது பாகம் தென் இந்தியாவின் ஒரு பகுதியாக கேம்பிறியன் காலத்திற்கு முன்பிருந்தே இணைந்திருந்தது என்றும், புவியோட்ட அசைவுகள் இடையிற் தொழிற்பட்டமைக்கு ஏற்ப தென்னிந்திய-இலங்கை திணிவுகளில் பிளவுகள் ஏற்பட்டு படிப்படியாக பிரிந்திருக்கின்றது என்றும் நிறுவப்பட்டுள்ளது.

தென்னிந்திய இலங்கை நிலத்திணிவுகளுக்கிடையே புவியோட்ட அசைவுகள் ஏற்பட்ட காலங்களில் உருவாக்கப்பட்ட தாழ்நிலங்களில் பிற்காலத்தில் கடல்கள் தோற்றம் பெற்றிருக்கின்றன. சில ஆய்வுகளின் படி லொரேஷியா - கொண்டுவானா நிலத்

திணிவுகளுக்கிடையே காணப்பட்ட கடலில் (ரெதிஸ்) ஒரு பகுதி சுமார் 20 மில்லியன் வருடங்களுக்கு முன் இந்தியாவின் மேற்குக் கரைவரை நீண்டு பின்னர் படிப்படியாக தென்னிந்திய - இலங்கைத்தாழ் நிலங்களுக்கிடையே ஊடுருவியிருக்கின்றது என்றும் அதன் விளைவாகவே இந்திய நிலத்திணிவில் இருந்து இலங்கை முதற் தடவையாக தனித்தீவாக உருப்பெற்று இருக்கின்றது என்றும் குறிப்பிடப்பட்டுள்ளது. (Corray, P.G. 1967).

இக்கடற்பகுதிகளில் படியவிடப்பட்ட மயோசின் கால சுண்ணாம்புப் படிவுகள் பிற்காலங்களில் மேலுயர்த்தப்பட்டதன் விளைவாக இலங்கையின் வட மேற்குக் கரையோரம் உட்பட யாழ்ப்பாணக் குடாநாட்டின் சில பகுதிகளும் கடலின் மேற்பரப்பிற்குக் கொண்டு வரப்பட்டிருக்கின்றன. மயோசின் காலத்தில் இருந்து தொடர்ந்து இன்று வரையிலான பல்வேறுபட்ட புவிச்சரித வெளியுருவ செயன்முறைகளின் விளைவுகளினாலேயே இலங்கைத்தீவு இன்றைய உருவவியலைப் பெற்றிருக்கின்றது. (படம் - 1) படத்தில் இலங்கையின் வடமேற்குக் கரையோரம் உட்பட யாழ்ப்பாணக் குடாநாடு எவ்வாறு உருப்பெற்றிருக்கின்றது என்பது காட்டப்பட்டிருக்கின்றது.

வடக்குக் கரையோரம் யாழ்ப்பாண குடாநாட்டின் தோற்றம்



படம்:1

யாழ்ப்பாணப் பிரதேசத்தின் வெளியுருவப்படிமுறை விருத்தி (பழையவிளக்கம்)

1. சுண்ணாம்புப்பாறை கடல் மட்டத்திற்கு வெளிப்படல்

2. வடமராட்சி மணற்படிவு உருவாகுதல்

3-4. பெருநிலப்பகுதிகளின் படிவாக்கம்

5. தென்மராட்சி மணற்படிவு உருவாகுதல்

6. இன்றைய குடாநாடு

தென்னிந்திய - இலங்கைப் பிரதேசங்களின் கடந்தகால புவிச்சரித நிலை

தென்னிந்தியாவுக்கும் இலங்கைக்கும் இடையே தற்போது ஒரு சிறுகடல் காணப்படுகின்றது. ஆனால், புவிவரலாற்றுக்கால ஆய்வுகளின்படி தென்னிந்தியாவுடன் சேர்ந்த ஒரு பகுதியாகவே இலங்கையின் பெரும்பகுதி (கேம்பிரியன் என்று அழைக்கப்படும் காலத்திற்கு முன்பிருந்து) இருந்திருக்கின்றது. அதாவது கொண்டுவானா (Gondwana land) என அழைக்கப்படும் ஒரு நிலத்தினிவில் தற்போதைய தென்கண்டங்களான தென் அமெரிக்கா, ஆபிரிக்கா, அவுஸ்திரேலியா மற்றும் அந்தாட்டிக்காவுடன் இந்திய நிலத்தினிவு இணைவுபட்டு இருந்ததாகவும் இந்தியாவுடன் இலங்கையும் இணைந்து இருக்க வேண்டும் என்று குறிப்பிடப்படுகின்றது. (A.Holmes, 1965) கொண்டுவானா நிலத்தினிவில் "கிறிட்டேஷியஸ் (135 மில்லியன் - வருடகாலம்) காலத்தில் முதல் தடவையாக உடைவு ஏற்பட்டு புவியோட்டு அசைவுகள் இடம்பெற்றிருப்பதும் இன்று உறுதிப்படுத்தப்பட்டுள்ளது. (படம் - 2)

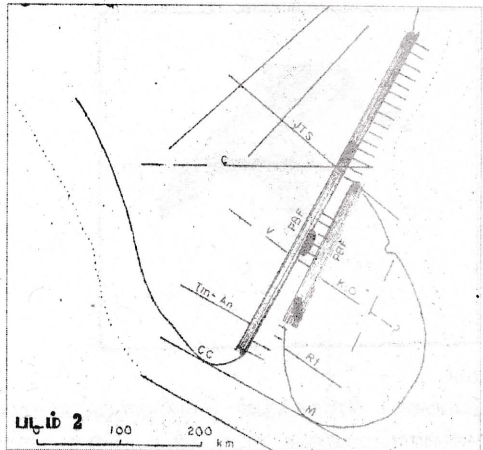
"கொண்டுவானா" நிலத்தினிவில் இந்தியாவும் இலங்கையின் பெரும்பகுதியும் எவ்வாறு இருந்திருக்கக் கூடும் என்பதை அறிய இவ்விரு நிலத் தினிவுகளையும் மீளப் பொருத்திப் பார்க்கும் ஆய்வு முயற்சிகள் பல இன்று வரை இடம்பெற்றுள்ளன. (Katz,

1978). இவ்வாய்வுகளின் பயனாக இன்றைய இந்து சமுத்திர அடித்தளம் (Indian Ocean Floor) "கடற்கரை பரவுதல்" (Sea Floor Spreading Processes) செயன் முறையின் விளைவால் எப்படி உருப்பெற்றிருக்கின்றது என்பது அறியப்பட்டுள்ளது.

(புவியோட்டின் உட்பாகத்தில் இடம்பெறும் விசைகளினால் திண்மமான மேலோடுகளில் பிளவுகள் ஏற்பட்டு கிடையாக அசைய, ஏற்படும் இடைவெளிகளில் புவியுட்பாக பொருட்கள் வெளிவந்து புகின்றன. இச்செயன்முறைகளினால் சமுத்திர அடித்தளங்கள் உருவாகின்றன.)

தென் இந்தியாவுடன் இலங்கையின் இணைப்பு

(ஒரு கண்டமேடையில் தென்னிந்திய - இலங்கை இணைவு. (தென்னிந்தியாவின் தென்கிழக்குப் பகுதியும் இலங்கையின் வடமேற்குப் பகுதியும் உருவாக்கம் பெற்றன)



தென்னிந்திய - இலங்கை யுறாசிக்கால புவியோட்டமைவு; பழைய பிளவு (PBF) வழியாக இந்திய இலங்கை நகர்வு நிகழ்தல். இன்று காணப்படும் (இரு தினிவுகளிலும்) பிளவோட்டக்கோடுகள் ஒரே ஒழுக்கில் அமைகின்றன.

சமுத்திர அடித்தளப் பாறைகள் உருவாகும் பொழுது ஏற்படும் பிளவு வலயங்களுடாகத் தொடர்ந்து அசைவுகள் இடம்பெறுகின்றன. இப்பிளவு வலயங்களும் (Transform Fault Zone) காலத்திற்குக் காலம் வேறுவேறாக அமைகின்றது. அந்தவகையில் நோக்கும் பொழுது, இந்திய - இலங்கைப் பகுதி அமைந்துள்ள இந்து சமுத்திரப் பகுதியில் மூன்று பிரதான காலகட்டங்களில் "கடந்தரைபரவுதல்" இடம் பெற்றிருக்கின்றது (கிறிட்டேஷியஸ் காலத்தின் ஆரம்பத்தில் 80 மில்லியன் வருடங்களுக்கு முன்). இன்றைய வங்காள விரிகுடாப் பகுதியிலும், பலியோசின் காலத்தில் (65 மில்லியன் வருடங்களுக்கு முன்) தென்இந்து சமுத்திரப் பகுதியிலும், ஒலிகோசின் காலப்பகுதியில் (30 மில்லியன் காலத்திற்குமுன்) இன்றைய அரபிக்கடற்பகுதியிலும் இவை ஏற்பட்டுள்ளன.

(Curry and Moore, 1974; Selater and Fisher, 1974; Mckenzin and Selater, 1973; Eremenko, 1968; Crady, 1971).

இந்துசமுத்திரத்தரையியல்



படம்:3

இந்துசமுத்திர கடந்தரை அமைப்பில் நடுச்சமுத்திர பாறை அமைப்பும், பிளவுகளும். (அம்புக்குறித்திசையில் புவியோட்டு அசைவுகள் இடம்பெறுகின்றன.)

படம் - 3இல் இன்றைய இந்து சமுத்திர தரையில் காட்டப்பட்டுள்ளது. இத்தரையில், விருத்தியடைந்த நடுச்சமுத்திரப் பாறைத் தொடர்களையும் பிளவுவலயங்களையும் காணக் கூடியதாகவுள்ளது. மேற்படி சமுத்திரத்தரை மூன்று துண்டுகளாக வேறு வேறு திசைகளில் நகர்வதையும் அம்புக் குறிகள் காட்டுகின்றன. தொடர்ந்தும் இவ்வசைவுகள் இடம் பெற்று வருவதும் குறிப்பிடத்தக்கது.

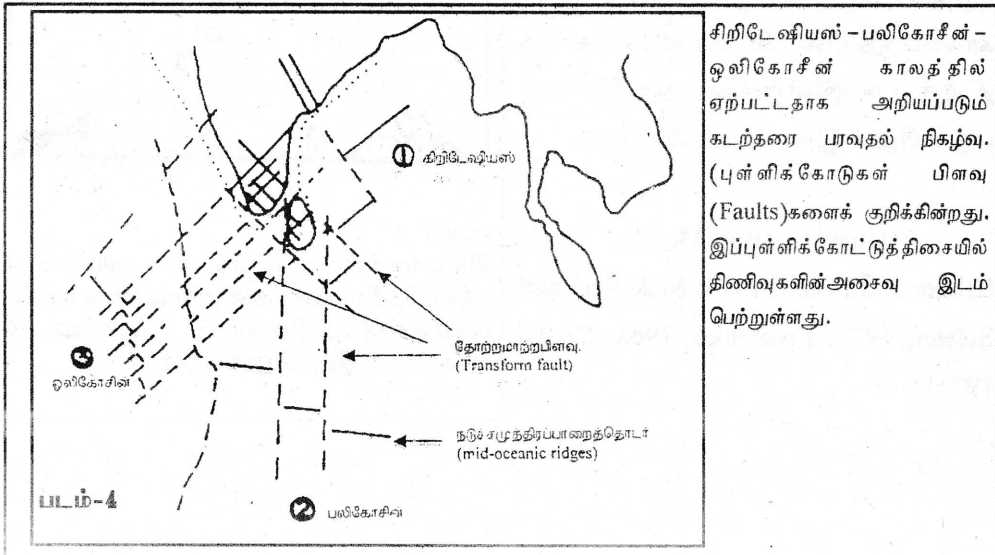
மேற்குறிப்பிட்ட மூன்று கால கட்டங்களின் போதும் புவியோட்டில் தோற்றம் பெற்ற பிளவுகள் (Faults) வழியாக நிலத்திணிவுகள் நகர்வு (Crustal movements) நிகழ்ந்து வந்திருக்கின்றது. மேற்படி, கடந்தரை பரவுதலின் போது உருவாகிய பிளவுகள் தென்இந்திய இலங்கை நிலத்திணிவுகளிலும் பிரதிபலிப்பதுடன்

இருநிலத்திணிவுகளிலும் அசைவுகளையும் ஏற்படுத்தியுள்ளது.

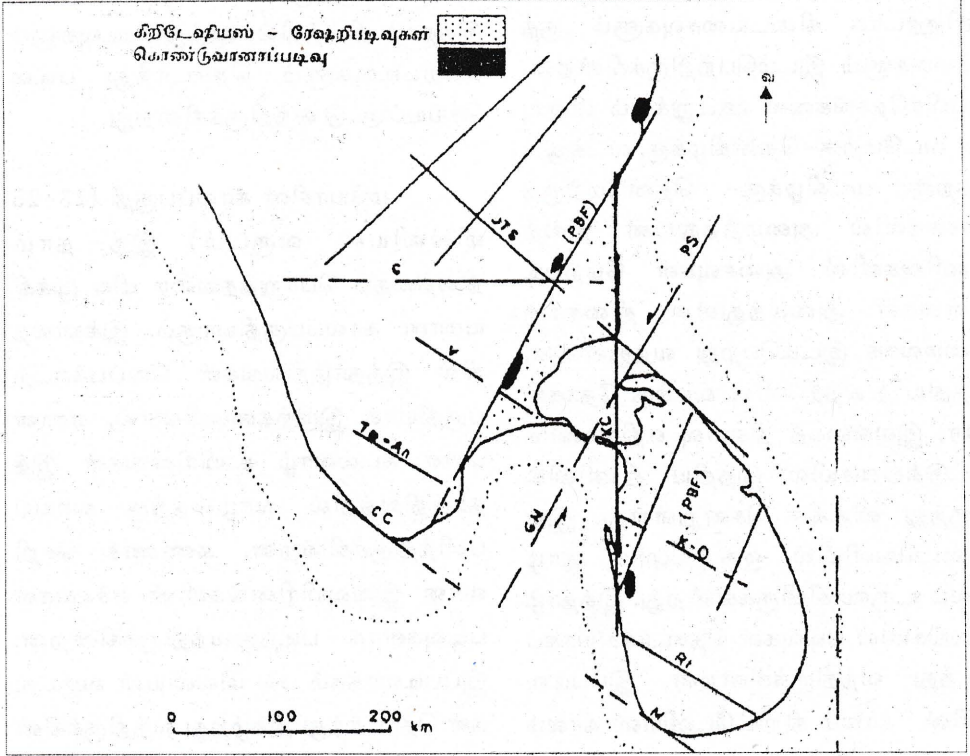
படம் - 4ல் இந்து சமுத்திர பரிமாணத்தின் போது தென் இந்திய - இலங்கைப் பகுதிகளில் விருத்தியடைந்திருக்கக்கூடிய பிளவு வலயங்களைப் பிரதிபலிக்கின்றது. (கிறிட்டேறியஸ் காலத்தின் பிற்பகுதி (80மில்.வருடம்), பிளையோசின் காலத்தின் பின்பகுதி(65 மில். வருடம்), ஒலிகோசின் காலம் (30 மில்லியன் வருடம்).

படம் - 5ல் தற்போதைய நிலையில் அடையாளம் காணப்பட்ட பிளவோட்டக் கோடுகளைக் காட்டுகின்றது. இத்தகைய அமைப்புக்களே (Structure) மேற்பரப்பு அம்சங்களை (Geomorphological features) நிர்ணயிப்பதாகவுள்ளது.

இந்து சமுத்திரச் சூழலில் கடந்தரை பரவுதல்



தென்கிந்திய - இலங்கை நிலத்தினிவுகளில் பிளவோட்டக்கோடுகள் இடம்பெயர்ந்துள்ள இன்றைய நிலை. (கிருநிலத்தினிவுகளிலும் கிறீட்டோவியஸ் - ரேஷிற்காலப்படிவுகள் படந்துள்ளது)



(படம்: 5 தற்போதைய நிலையில் அடையாளம் காணப்பட்ட பிளவோட்டுக்கோடுகள்)

- C - காவேரி பிளவோட்டுக்கோடு
- V-Ko - வைகை கல்லூயா விளவோட்டுக்கோடு
- TM-AM - தம்பிரபாணி, அன்கோவில் இரத்தினபுரி பிளவோட்டுக்கோடு
- CC-M - குமரிமுனை - மாத்தறை பிளவோட்டுக்கோடு
- JTC - யாழ்ப்பாணம் - திருலங்கூர் -சேலம் பிளவோட்டுக்கோடு
- PBF - இந்தியா - இலங்கை பிரிவதற்கு முன்னர் இருந்த எல்லைப்பிளவு
- PS-GM - பாக் மன்னார் குடா அசைவு வழி அச்சு
- KC - காரைக்கால் - சிலாபம் பிளவோட்டுக்கோடு

தென்கிந்திய- இலங்கை நிலத்திணிவு கருக்கிடையே தாழ்நிலம் உருவாதல்

இந்து சமுத்திர அடித்தள விருத்தியின் போது ஏற்பட்ட பிளவாக்கங்களினூடாக கிடையசைவுகளும் குத்தசைவுகளும் இடம்பெற்றிருக்கின்றன. இப்பிரதேசங்களை ஊடறுக்கும் பிளவுகள் வடமேற்கு - தென்கிழக்கு, வடக்கு - தெற்கு, வடகிழக்கு - தென்மேற்குத் திசைகளில் அமைந்ததுடன் நிலத்திணிவுகளின் அசைவுகள் மேற்படி பிளவுகள் அமைந்துள்ள திசைக்கு அமைவாக இடம்பெற்று வந்துள்ளன. இந்திய நிலத்திணிவு வடக்கு நோக்கி நகர, இலங்கைத் திணிவு எதிர்மணிக் கூட்டுத்திசையில் இந்திய திணிவில் இருந்து விலகிச் சென்றுள்ளது. இவ்விடைவெளியில் ஒரு பெரிய தாழ்நிலம் உருவாகியிருக்கின்றது. இத்தாழ்நிலங்களில் படிவுகள் தொடர்ச்சியாகப் படிந்து வந்திருக்கின்றன. இப்படிவுகளின் காலம் கிறிட்டேஷியஸ் காலம் தொடக்கம் இன்றுவரையான வயதைக் கொண்டவையாக இருக்கின்றன. தொடர்ச்சியானதும், ஆனால் மெதுவானதுமான அசைவுகள் இத்தாழ்நிலங்களில் இடம்பெற்றுக் கொண்டு வருவதாகவும் அதற்கேற்ப தாழ்நிலத்தின் இடவிளக்கத் தன்மை விருத்தியடைந்திருப்பதாகவும் அறியப்பட்டுள்ளது.

இன்றைய காவேரி வடிநிலத்தின் தரையமைப்பு மேற்கூறப்பட்ட

நிலைமைகளுக்கு ஏற்ப்படிப்படியாக விருத்தியடைந்து இன்றைய நிலையை எட்டியிருக்கின்றது. புவியோட்டு அசைவுகளுக்கு ஏற்ப உருவாக்கப்பட்ட இத்தாழ்நிலத்தில், ஆற்றுப்படிவுகளும் கடற்படிவுகளும் தொடர்ந்து படிவு செய்யப்பட்டு வந்திருக்கின்றது.

மயோசின் காலப்பகுதி (13-25 மில்லியன் வருடம்) இத் தாழ்நிலத்தைப் பொறுத்தவரை மிக முக்கியமான காலப்பகுதியாகும். இக்காலத்தில் இத்தாழ்நிலங்கள் வெப்பக்கடற்பகுதியாக இருந்தமையினால், ஏராளமான கடல்வாழ் உயிரினங்கள் இத்தாழ்நிலத்தில் வாழ்வதற்கு வாய்ப்பளித்திருக்கின்றன. சுண்ணச் செறிவான இவ்வுயிரினங்களின் எச்சங்கள் படிவுகளாக படிந்துவந்திருக்கின்றன. இப்படிவாக்கம் பல மில்லியன் வருடங்கள் தொடர்ந்து நிகழ்ந்து வந்திருக்கின்றன. இதனால், படிவுகள் கிடைத்தளமான முறையில், பெரும்பாலும் புவியுட்பாக விசைகளினால் பெரிதும் குழப்பப்படாத வகையில் படிவாக்கம் இடம்பெற்றுள்ளது. இப்படிவுகள் பிறகாலங்களில் மயோசின் கால சுண்ணப்பாறை என அழைக்கப்பட்டது. இப்படிவுகள் அதன் கீழ் உள்ள அடித்தளப்பாறைகளின் பிளவு, மற்றும் அதன் அசைவுகளுக்கு ஏற்றால் போல் ஒழுங்குபடுத்தப்பட்டிருக்கின்றன. இதன்

காரணமாகவே பாறைகளின் மேற் பரப்பு அமைப்புக்கள் நிர்ணயிக்கப் பட்டுள்ளன. (மேடுபள்ளமான வெளியுருவ நிலை) இந்த அமைப்பு நிலையையே இன்றும் காவேரி-பாக் தாழ் நிலம் பிரதிபலிக்கின்றது.

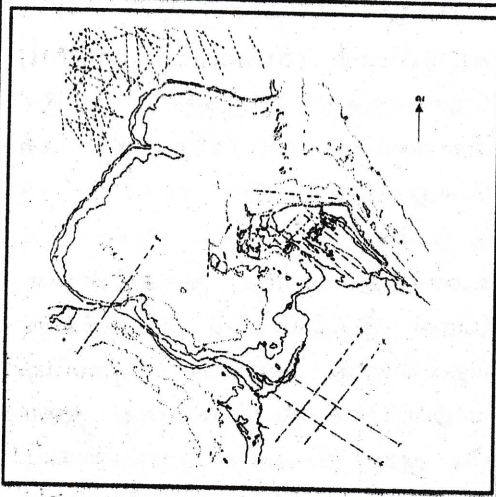
மயோசின் காலத்தில் (இன்றில் இருந்து 13-25 மில்லியன் வருடங்கள் கொண்ட காலப்பகுதி) படிவாக்கம் செய்யப்பட்ட படிவுப் பாறைகள் படிப்படியாக குத்துயர்ச்சி மூலம் கடல் மட்டத்திற்கு மேல் வெளிப்படுத்தப் பட்டது. தென் இந்தியாவிலும் வடமேற்கு இலங்கையிலும் அவற்றின் கரையோரங்களில் மயோசின் கால பாறைவகை இந்தவகையிலேயே உருப்பெற்றிருக்கின்றது. கடல் மட்டத்திற்கு மேல் வெளிப்பட்டவை போக, ஏனையவை கடற்கீழ் சுண்ணப் பாறைகளாக அமைந்திருக்கின்றன. எனவே, இலங்கையின் வடமேற்குக் கரையோர உருவவியலில் மாற்றங்கள் ஏற்படுவதற்கு இப்பாறைகள் முக்கிய காரணமாக அமைந்திருக்கின்றன. தொடர்ந்தும் கடற்படிவுகளும், ஆற்றுப்படிவுகளும் இத்தாழ்நிலங்களில் படிவாக்கம் பெற்று வந்ததுடன் இலங்கையின் வடமேற்குக் கரையோர வெளியுருவ அம்சங்களை மாற்றியமைத்து வந்திருக்கின்றன.

தொடர்ந்து வந்த காலங்களிலும் படிவாக்கங்கள் இடம்பெற்று வந்த போதிலும் அடித்தள அசைவுகளின் கட்டுப்பாடு (Structural control) தொடர்ந்தும் இருந்து வந்திருக்கின்றமையை இப்பிரதேசத்தில் தற்போது காணப்படும் காவேரி-பாக் தாழ்நில வெளியுருவ அம்சங்கள் உணர்த்துவனவாக இருக்கின்றன. (தென் இந்தியாவின் வடகிழக்கு - தென்மேற்கு கரையோர அமைப்பு, யாழ்ப்பாணக் குடாநாட்டினது அமைப்பு, அதன் தீவுகளின் ஒழுங்கமைப்பு, ஆதாம்பாலம், சம ஆழக்கோடுகள், ஆழ்கடற் பள்ளங்களின் அமைப்பு போன்றன.)

இவை கிறிட்டேஷியஸ், பிளை யோசின், ஒலிகோசின் கால சமுத்திர அடித்தள பிளவுகளின் திசைப் போக்கு களுடன் ஒத்துவருகின்றன. (படம்-6)

படத்தில் தென்இந்திய-வடமேற்கு இலங்கைப் பகுதிகளிலும் ஆய்வுகள் வாயிலாக அறியப்பட்ட உடைவுகள், பிளவுகள் போன்றவற்றின் திசைகளைக் காட்டுகின்றன. இவை காணப்படும் பகுதிகள் தாழ்நிலங்களாக அமைவதுடன் இவற்றிற்கு கடைப்பட்ட பகுதிகள் உயர்நிலங்களாக அமைகின்றன.

**வடமேற்கு-இலங்கை தென்கிழக்கு
கிந்தியக்கரையோரம்.**



படம்:6

தென் இந்தியப் பகுதிகளிலும், இலங்கையின் வடபகுதியிலும் மயோசின் பாறைகளில் காணப்படும் பிளவொட்டக்கோடுகளின் அமைவு. வடக்கு-தெற்கு, வடமேற்கு - தென்கிழக்கு, வடகிழக்கு - தென்மேற்கு போக்குகளில் பிளவொட்டக்கோடுகள் அமைந்திருக்கின்றன.

காவேரி - தாழ்நிலப்பகுதியில் காலத்திற்குக் காலம் கடல்மட்ட மாற்றங்களும், புவி அசைவுகளும் இடம்பெற்றிருப்பதற்கு ஏற்பவே அதன் வெளியுருவவியல் அம்சங்கள் படிப்படியாக உருப்பெற்று இன்றைய நிலையை அடைந்திருக்கின்றன. மயோசின் கால முடிவிற்குப் பின்னரும் தொடர்ந்து வந்த புவியோட்டசைவுகளும் கால நிலை மாற்றங்களும் இவற்றின் காரணமாக ஏற்பட்ட வெளியுருவ

செயன்முறைகளினால் நிலத்திணியு களின் உருவவியல்களிலும் மாற்றங் கள் ஏற்பட்டு வந்திருக்கின்றன. ஆனாலும் இப்பிரதேசங்களின் புவி யோட்டு அசைவுகளின் கட்டுப்பாடு களுக்கு ஏற்பவே அவற்றின் இன்றைய உருவவியற் கோலங்களும் அமைந்துள் ளன. இந்தவகையில்தான், இலங்கை- ஆதாம்பாலம் அமைப்புகளும் விளங்கிக் கொள்ளப்பட வேண்டும்

குவாட்னறிகால புவிவெளியுருவ செயன் முறைகள்

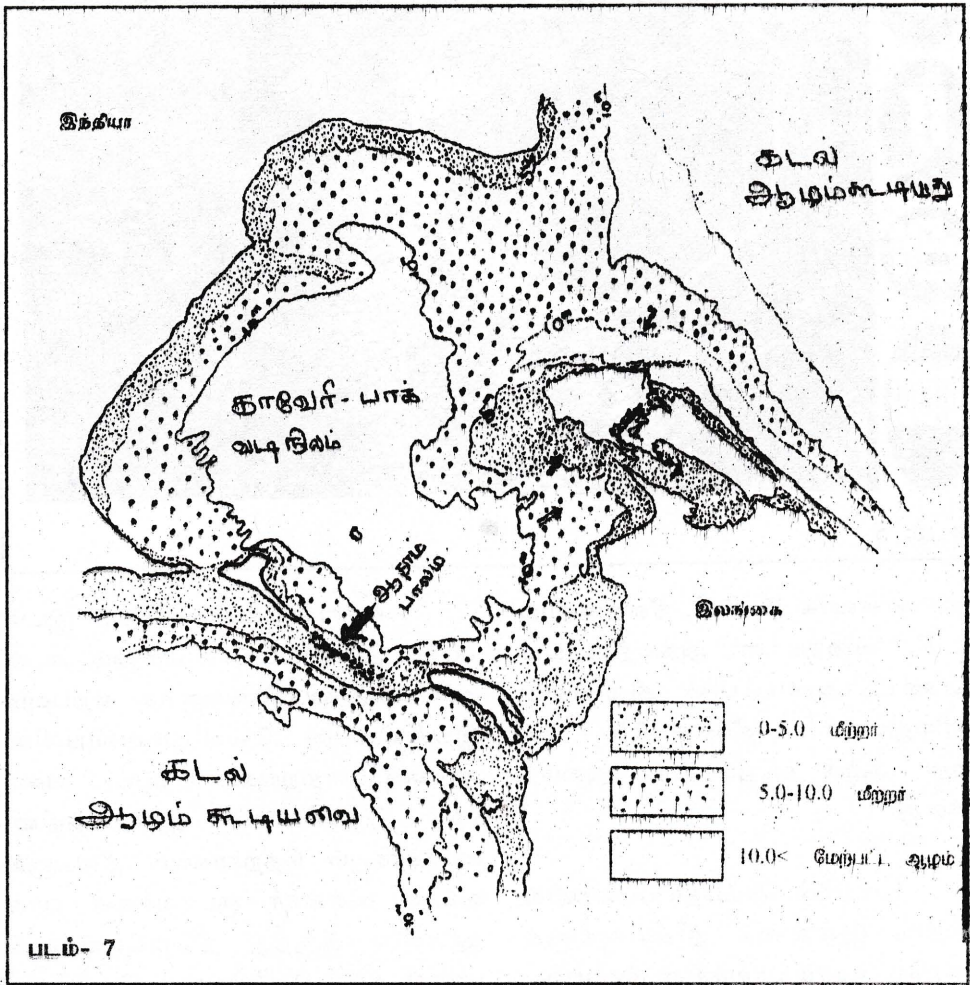
குவாட்னறிகாலம் புவிச்சரித வரலாற்றுக் காலத்தின் அண்மைக் காலம் எனலாம். இது 2.0 மில்லியன் வருடங்களுக்கு முற்பட்ட காலப்பகுதி யாகும். இக்காலப்பகுதியில் தென் இந்தியா, இலங்கை பிரதேசங்களின் எல்லைகளைச் சூழ கடற்படிவுகளும், நிலத்தில் இருந்து வந்த படிவுகளும் கலந்து படிவுற்றதுடன், கால நிலை மாற்றங்களால் இப்பிரதேச வடிகால்க ளினதும் கடல்மட்டங்களிலும் மாற்றங் கள் ஏற்பட்டுள்ளதாக அறியப்பட்டுள் ளது. இதன் காரணமாக இப்பிரதேசங் களில் சிக்கலான உருவவியல் அம்சங்கள் இடம்பெற்றுள்ளன. இன்று நாம் காணும் தென் இந்தியாவுக்கும்- வட மேற்கு இலங்கைக்குமிடையில் அமைந்துள்ள “ஆதாம்பாலம்” அல்லது “இராமர் அணை” என்னும் அமைப்பு இத்தகைய சிக்கலான உருவவியல் அமைப்புகளில் ஒன்றாகக் கருதமுடியும்.

இலங்கை ஆதாம்பாலம்

தென்னிந்தியாவின் "பாம்பன் தீவு"க்கும் வடமேற்கு இலங்கையின் மன்னார் தீவுக்கும் இடையில் அமைந்துள்ள "ஆதாம் பாலம்" அண்ணளவாக 79° - 41' கிழக்கு நெடுங்கோட்டில்

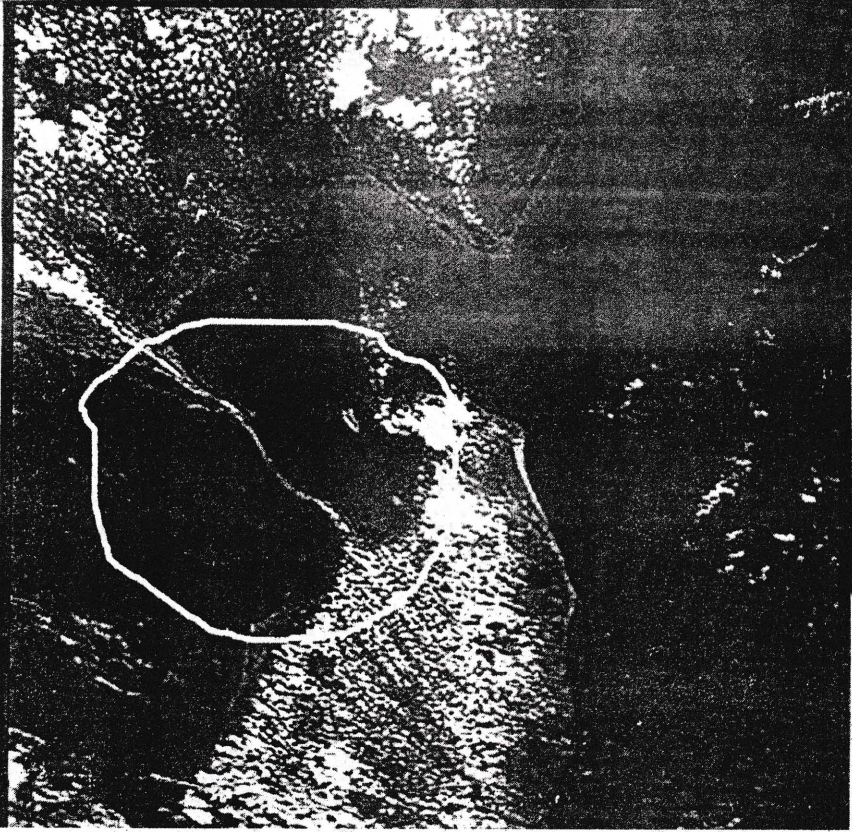
9° 03' வடக்கு 9° 05' வடக்கு அகலக் கோட்டுப் பகுதிக்குள் அமைந்துள்ளது. பாக் குடாவுக்கு தென்புறமாக பாலம் உட்குழிவான அமைப்பைக் கொண்டதாக அமைந்துள்ளது.

ஆதாம்பால இடவமைப்பு



காவேரி - பாக். குடாபகுதியினைச்சூழ கடல் ஆழநிலையும் 'ஆதாம்பால' நிலையும்

கிராமர் அணை



படம்: 8

அண்ணளவாக 30 கி.மீ. நீளத்தையும் 2 கி.மீ. வரையான அகலத்தையும் கொண்ட அமைப்பில் சிறியதும் பெரியதுமான 14 தீவுகள் 0.0 - 2.0 மீற்றர் ஆழக் கடற்பரப்புள் அமைந்துள்ளது.

(படம் 8ல் செய்மதிப்படங்களில் இந்திய - இலங்கை திணிவுகளுக்கிடையே ஆதாம் பாலத்தின் இன்றைய நிலை அறியப்பட்டுள்ளது.)

பருவகாலங்களுக்கேற்ப இடம் பெறும் நீரோட்டங்களினாலும் கடல் மட்ட ஏற்றவிறக்கங்களுக்கு ஏற்பவும் இத்தீவுகளின் வெளியுருவவியலில் அடிக்கடி மாற்றங்கள் ஏற்பட்ட வண்ணம் இருக்கின்றன. இக்காலத்தின் வடக்காகவும் தெற்காகவும் தீவுகளுக்கூடாக மன்னார் குடாவுக்குள் பாக்குடாவில் இருந்து நீரோட்டங்களும் மணல் நகர்வும் வேகமாக இடம்பெறுகின்றன.

ஆதாம் பாலத்திற்கு மேற்குப் புறமாக பாம்பன் தீவும், கிழக்குப் புறமாக மன்னார் தீவும் காணப்படுகின்றது. இவ்விணைப்பு தென்னிந்தியாவுக்கும் இலங்கைக்கும் இடையிலான ஓர் இடைவிட்ட நிலப்பாலமாக அமைந்துள்ளது. இவ்விணைப்புக்குத் தெற்காக பழைய கடற்கரைகளுக்கான எச்ச அடையாளங்கள் அவதானிக்கப்பட்டுள்ளன. இக்கரையோரம் சம ஆழக் கோடுகளுக்கு சமாந்தரமாக வளைந்த நிலையில் காணப்படுகின்றது.

சிலாபத்துறை, வங்காலை முருகைப்பார் தொடர் தென்னிந்தியாவின் (மன்னார் குடா நோக்கிய) கரையோரத்தில் அமைந்துள்ள "மணலி தீவு" (Mannalli tivu), "முல்லைத்தீவு" (Mulitivu), "வலைத்தீவு" (Valai tivu), "தலைறிதீவு" (Talairi tivu) "பாலையாமுனைதீவு" (Balaiyamunai tivu), போன்ற பல தீவுகளுடன் தொடர்புபடுத்தக்கூடிய நிலையில் உள்ளது. இம்முருங்கைப்பார்க்கள் கடல் மட்டத்தில் இருந்து 3.5 தொடக்கம் 4.5 மீற்றர் ஆழத்தில் உள்ள அடிப்பாறைகள் மேல் வளர்ச்சி பெற்றுள்ளன. ஆதாம் பாலத்திற்கு வெளிப்பக்கமாக முருங்கைப்பாறைகள் வளர்ச்சியடை வில்லை. இப்பகுதியின் பௌதீகச் சூழல் முருங்கைப்பாறைகளின் வளர்ச்சிக்கு சாதகமாக அமையாமையே இதற்குக் காரணமாக அமையுலாம். (நீரோட்டம், மணல் படிவுகள்). இப்பகுதியின் கடல்

மட்டத்தில் இருந்து 10-11 மீற்றர் ஆழத்தில் தடுப்புப்பார் (Barrier type) மாதிரியான மணற் கல்லால் ஆன பாறைத்தொடர் காணப்படக்கூடும் என நம்பப்படுகின்றது. (Swan, B.1903).

இலங்கையின் மன்னார் தீவுடன் தொடர்புபட்ட "ஆதாம் பாலம்" இந்தியாவின் இராமேஸ்வரம் தீவுடன் தொடர் கொண்ட அமைப்பாக தென்கிழக்கு-வடமேற்குப் போக்கில் ஓர் தொடர் (Ridge) போல அமைந்திருக்கின்றது. இத்தொடர்பு போல, யாழ்ப்பாணக் குடாநாட்டின் நெடுந்தீவு, இராமேஸ்வரம் தீவுகள் வடகிழக்கு-தென்மேற்குப் போக்கில் அமைவது போல காணப்படுகின்றது.

இது போன்ற பல்வேறு சமுத்திர அடித்தள அமைப்புக்களை கடல் ஆழப்படங்களை நோக்கும் பொழுது புலனாகின்றது. தென்னிந்தியா இலங்கைக் கண்டமேடைப் பகுதிக்குள் காவேரி பாக் தாழ்நிலம் தனித்துவமான வெளியுருவ அமைப்பைக் கொண்டதாக விளங்குகின்றது.

புவிச்சரிதகால காலநிலை

புவி வரலாற்று ஆரம்ப காலங்களில் எத்தகைய காலநிலை நிலவிவந்துள்ளது என்பதை அறிவது எளிதல்ல, ஆனால் புவிச்சரித வரலாற்றுக் காலங்களின் பிற்பகுதிக்குரிய காலங்

களில் நிலவியிருக்கக் கூடிய கால நிலைகள் பற்றி ஓரளவுக்கு அறியக் கூடியதாகவுள்ளது. அயனப் பகுதிகளில் மயோசின் காலத்திற்குப் பிற்பட்ட காலப்பகுதியில் பெரும் மழைக் காலங்களும் ஈரக்காலங்களும் (Pluvial and Inter pluvial periods in tropical regions) ஏற்பட்டிருப்பதாக அறியப்பட்டுள்ளது.

(Duplessy, 1982, Davies and clifton, 1907, Fair bridge, 1961, 1962, Guikher, 1969, Pirazoli, 1987, Thomson, 1989, Tooley, 1987, Walooof, 1972, Vaidyanathan. R.1971, Weerakoddy, U. 1988, 1993, Vidiyanathan, 1981)

குறிப்பாக இடைவெப்பப் பகுதிகளில் இடம்பெற்ற குவாட்னறி கால பனியாக்க நிகழ்ச்சிகளை அயனப் பகுதிகளில் இடம்பெற்ற பெரும் மழைக்காலங்களுடன் தொடர்புபடுத்தி கின்றது.

தென்னிந்திய இலங்கை குழல்களிலும் இத்தகைய காலநிலை பெரும் தாக்கத்தை ஏற்படுத்தியிருக்கலாம். குறிப்பாக கடல்மட்ட உயர்வு, தாழ்வு மற்றும் வரட்சி, வடிகால்களில் மாற்றங்கள், படிவுறுதல் நிகழ்வுகள் போன்றவற்றில் பெரும் விளைவுகள் நிகழ்ந்திருக்க வேண்டும் என நம்பப்படுகின்றது:

பிளித்தோசின்-கொலோசின் கால கடல் மட்ட மாற்றங்கள்

குவாட்னற் காலத்தின் மிகமிக அண்மிய காலமாக பிளித்தோசின் (18,000 வருடங்களுக்கு முன்) கொலோசின் (10,000 வருடங்கள்) காலத்தைக் குறிப்பிடலாம். இக்காலத்தில் தென்னிந்திய-இலங்கைச் சூழல்களில் கடல்மட்ட உயர்வு தாழ்வுகள் இடம்பெற்றுள்ளமை அறியப்பட்டுள்ளது. இந்நிகழ்வுகளின் விளைவாக நிலத்திணைவுகளினதும் குறிப்பிடத்தக்க உருவவியல் மாற்றங்கள் ஏற்படுத்தப்பட்டுள்ளன.

(Fair bridge, 1961, 1963, Thomson, 1989, Tooley, 1987, Vaidyanathan, 1989)

இன்றிலிருந்து 18,000 ஆண்டுகளுக்கு முன், தற்காலத்தில் காணப்படும் கடல்மட்ட அளவுகளைவிட குறைந்தது 100 மீற்றர் வரையில் கடல் மட்டம் குறைந்திருக்க வாய்ப்புண்டு என அனுமானிக்கப்பட்டுள்ளது. (Prellet.al. 1970, Kolla Biscaru, 1977,) பின்னர், பனிக்கட்டி உருகுதலின் விளைவாக (வெப்பகாலம்) கடல் மட்டம் படிப்படியாக உயரத் தொடங்கியிருக்கின்றது. (Oleman and Robert, 1989) இதுவே கொலோசின்கால கடற்பெருக்கு எனப்படுகின்றது.

உலகளாவிய ரீதியாக கடல் மட்டம் உயர்ந்த பொழுது (18,000-

6,000) வரை யான காலப்பகுதிகளில்) தாழ்நிலப் பரப்புக்கள் கடலில் மூழ்கியதன் விளைவாக உயர் நிலங்கள் நீரினால் சூழப்பட்ட நிலையில் தீவுகளாக மாறியிருக்கின்றன. உதாரணமாக தஸ்மேனியாதீவு இக்காலங்களில் அவுஸ்திரேலியாவில் இருந்து பிரிந்த தீவாகியிருக்கின்றது. (Brid, 1987).

இந்திகழ்வுகளுக்கு ஒப்பாகவே தென் இந்திய - இலங்கையை அண்டிய தாழ் நிலங்களில் கடல்மட்டம் உயர் நிலத்திணைவுகளின் உருவவியல்களில் மாற்றங்கள் ஏற்படலாயிற்று.

தென் இந்திய - இலங்கை சூழல்களில் மேற்கொள்ளப்பட்ட "கொலோசின்கால" கடற்பெருக்கு பற்றி பல ஆய்வுகள் இதுவரை மேற்கொள்ளப்பட்டுள்ளன.

(Kamewwara Rao and Desikan, 1990, Krishnarao, Bhanumoorthy, Srinivasarao and Rahendra Prasad, 1990, Loveson and Rajamanikam, 1987, 1989, Jinadasa and Katupotha, 1988, Katupotha and Fujiwara, 1988; Fairbridge, 1961, Walcott, 1972, Pirazzoli, 1987, Davies, 1987)

மேற்குறித்த ஆய்வுகளின் முடிவுகளை அடிப்படையாகக் கொண்டு நோக்கும்போது பிளித்தோசின் கொலோசின் கால கடற்பெருக்கு தொடர்

பாக தென்னிந்திய இலங்கைக்கு இடையிலான சூழலில் இடம்பெற்றிருக்கக் கூடிய நிலைமைகளைப் பின்வருமாறு அனுமானித்துக்கொள்ள முடிகின்றது.

1. இன்றிலிருந்து 18,000 வருடங்களுக்கு முன்னர், காவேரி பாக். வடிநிலப் பகுதிகளில் வரண்ட காலநிலை நிலவியிருக்கின்றது. இன்று காணப்படும் கடல்மட்ட அளவுகளைவிட மிகவும் தாழ்மட்டங்களில் அன்றைய கடல்கள் இருந்திருக்கின்றன. அதாவது இன்றைய கடற்கரையோரம் வெகு தூரத்திற்கு பின்னோக்கி அமைந்திருக்கின்றது.

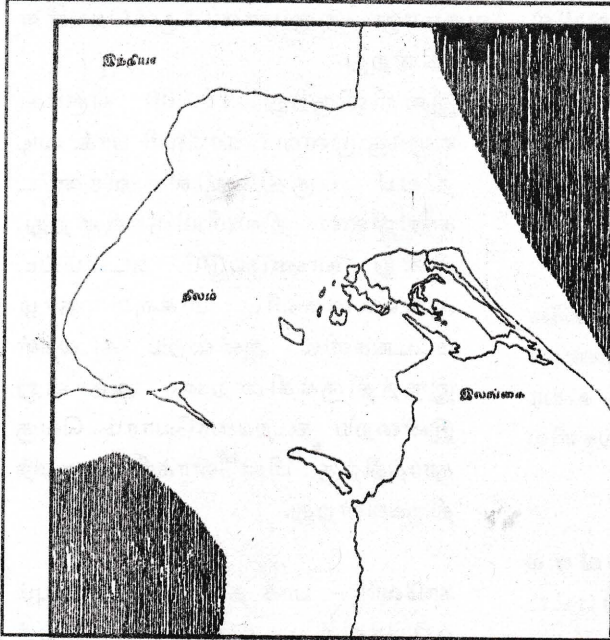
காவேரி - பாக் தாழ்நிலப்பகுதியும் ஒப்புரவற்ற தரையமைப்பைக் கொண்டிருக்கின்றன. இதற்கு, சமுத்திர அடித்தள பிளவு வலயங்களின் அசைவுகள் காரணமாக இருந்திருக்க வேண்டும்.

2. காவேரி பாக் தாழ்நிலங்களில் கடல்மட்டம் உயர் உயர் தாழ்ப்பகுதிகள் கடலில் அழிந்துவிட்டன. இச்செயன்முறையின் விளைவால் நிலப்பரப்புக்கள் சுருங்கி வரத் தொடங்கியிருக்கின்றது.

இன்றிலிருந்து 7,000 வருடங்களுக்கு முன், இன்றைய கடல்மட்டத்தை விட காவேரி - பாக் தாழ்நிலத்தில்

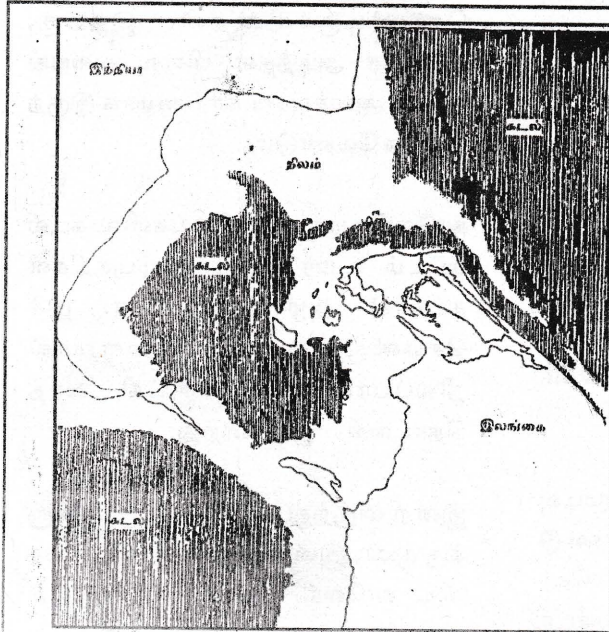
10 மீற்றர் குறைவாகவே கடல் மட்டம் இருந்திருக்கலாம். இந்நிலையில் இப்பகுதியில் இன்றைய 10

மீற்றர் ஆழக்கோடே இக்கால கடல் எல்லையாகக் கருதவிடமுண்டு.



படம்:09

இன்றைய கடல் மட்டத்தைவிட 80.0 மீட்டர் கடல்மட்டக் குறைவு. (80.0 மீட்டர் சம ஆழக்கோட்டினை கடல் எல்லையாகக் கொண்ட பொழுது அமையும் இந்திய - இலங்கை தரை அமைப்பு (இன்றில் இருந்து 18000 வருடங்களுக்கு முன் LGM காலத்தில் இருந்த நிலை) (LGM: Last Glacial Maximum)



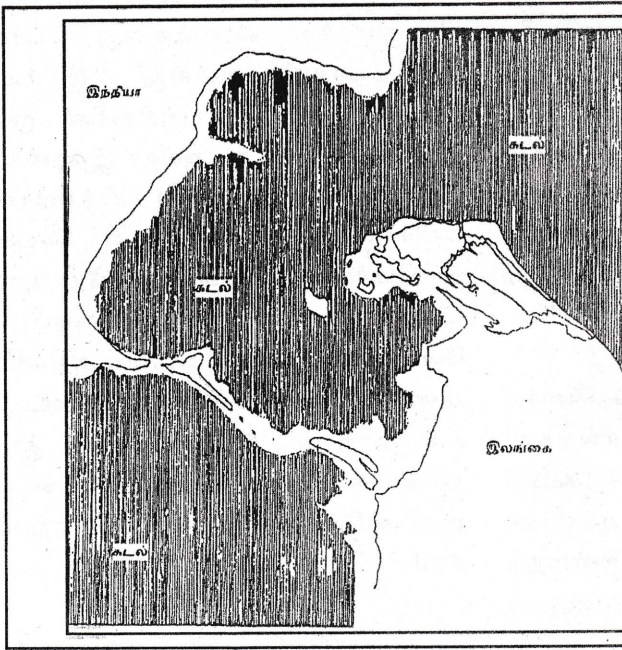
படம்:10

இன்றைய கடல் மட்டத்தைவிட 10.0 மீற்றர் கடல்மட்டம் குறைந்த நிலை, கடற்பெருக்கின் மூலம் இந்திய - இலங்கை நிலப்பகுதிகள் குறைந்து வருதல். நெடுந்தீவு உட்பட இன்றைய தீவுக்கூட்டங்கள் யாழ்ப்பாணக் குடாநாட்டுடன் இணைந்து ஒரே நிலத்திணியாக காணப்படல்.

படத்தில் இன்றைய தென் இந்தியாவின் கரையோரமும் இலங்கையின் வடமேற்குக் கரையோரமும், மேற்குக் கரையோரமும் அகலமாக இருப்பதுடன் இராமேஸ்வரப் பகுதிக்கும் மன்னாருக்கும் இடைப்பட்ட பகுதி ஒடுங்கி வந்துள்ளமையும் அனுமானிக்கக் கூடியதாகவுள்ளது. குறைந்தது ஒரு வருடத்திற்கு 1.0

செ.மீ.என்ற அளவில் கடல்மட்ட உயர்வு அதிகரித்திருக்கலாம் என நம்பப்படுகின்றது.

3. வருடாந்த கடல் மட்ட அதிகரிப்பின் அளவின்படி 6500 வருடங்களுக்கு முன் இப்பிரதேசங்களின் கரையோரம் தற்காலத்தின் 5.0 மீற்றர் சம ஆழக்கோடாக இருக்க வேண்டும்.



படம்:11

இன்றைய கடல் மட்டத்தைவிட 5.0 மீட்டர் கடல் மட்டம் குறைந்த நிலை. நெடுந்தீவு தனித்தீவாக உருப்பெற்று விட்டது. ஏனைய தீவுகளும் குடாநாடும் ஒரே நிலத்திணியாக காணப்படுகின்றது. (இன்றில் இருந்து 1000 வருடங்களுக்கு முன்னர்.)

4. தொடர்ந்தும் கடல்மட்டம் அதிகரித்து வந்ததன் விளைவாக இன்றில் இருந்து 6,000 வருடங்கள் அளவில் இன்றைய கடல்மட்டத்தைப் பெற்று இருக்கின்றது என்று அறியப்பட்டுள்ளது. எனினும் கடல்மட்ட உயர்வு, தாழ்வு பின்வந்த காலங்களிலும் இடம்பெற்றிருக்கின்றன என்றும் சில ஆய்வுகள் தெரிவிக்

கின்றன. (Krishnan rao and Desikan, 1990).

இதன்படி நோக்கும்பொழுது, இன்றைய இலங்கையின் கரையோரங்கள் கூட கடலில் மூழ்கியிருக்க வேண்டும் என்று கருதுவதற்கும் இடமுண்டு.

5. தற்போதைய தென்னிந்திய - இலங்கை கரையோர உருவவியலை நோக்கும்போது **இராமேஸ்வரம் - ஆதாம்பாலம் - மன்னார் தீவுத் தொடர்**கள் நிலப்பாலம் போல கடலால் மூழ்கடிக்கப்படாமல் கடல் மட்டத்திற்கு மேல் காணப்படுகின்றன. இவ்வமைப்பு வடமேற்கு - தென்கிழக்குப் போக்கில் அமைந்த பிளவு வலயங்களினிடையே காணப்படும் உயர் நிலமாக இருப்பதனாலேயே இன்றுவரை கடல்மட்ட உயர்வினால் பாதிக்கப்படவில்லை. மேலும் வடகிழக்கு தென்மேற்குப்பக்கமான புவியோட்டு அசைவின் காரணமாகவே ஆதாம் பாலம் வளைந்த அமைப்புடன் காணப்படுவதாகவும் கொள்ளலாம்.

தென்னிந்தியா - இலங்கைப் பகுதிகளில் புவிச்சரித காலங்களினூடாக இடம்பெற்றிருக்கக் கூடிய சிக்கலான செயன்முறைகளின் விளைவுகளே, இவற்றின் இன்றைய உருவவியல் தன்மைக்குக் காரணமாக அமைகின்றன எனலாம்.

சாதாரணமாக தென் இந்திய - இலங்கைப் பிரதேசங்களை நோக்கும் போது ஒருவருக்கு, இந்தியாவையும் இலங்கையையும் இணைக்கும் ஒரு நிலப்பாலம் (Land bridge) போல இராமேஸ்வரம் ஆதாம்பாலம் - மன்னார் தீவு காணப்படுகின்றது. இந்திய -

இலங்கை கண்டமேடையின் சிக்கலான, ஒப்புரவற்ற கடற்படுக்கையின் உருவவியல் நிலைமைகளை அதன் புவிச்சரித - புவிவெளியுருவ செயன்முறைகள் ஊடாகவே விளங்கிக் கொள்ள முடியும். அவ்வாறு விளங்கிக் கொள்ளும் நிலைமையிலேயே இந்திய - இலங்கை நிலத்திணிகளின் உருவவியல் மாற்றங்களையும் விளங்கிக் கொள்ள முடியும். ஆகவே முடிவாக பொதுமக்கள் விளங்குவது போல ஆதாம்பாலம் அல்லது "இராமர் அணை" மனித முயற்சிகளின் மூலமாக கட்டப்பட்டது அல்ல. இத்தகைய அமைப்பு நீண்டகால சிக்கலான புவிச்சரித, புவிவெளியுருவ செயன்முறைகளின் விளைவாக தோற்றம் பெற்ற அமைப்பாகவே கருதப்பட வேண்டும். கோள வெப்ப அதிகரிப்பின் காரணமாக மேலும் கடல் மட்டம் உயருமானால் இன்னும் சில நூற்றாண்டுகளில் இந்த அமைப்பு கடலினுள் அமிழ்ந்துவிடும் நிலையும் ஏற்படலாம்.

புவிச்சரித காலங்களினூடாக, பல்வேறுபட்ட புவியுட்பாக, வெளிப்புற செயன்முறைகளினால் தென்னிந்திய - இலங்கை கண்ட மேடைப் பகுதிகளில் பாரிய உருவவியல் மாற்றங்கள் ஏற்பட்டு வந்துள்ளன. இந்திகழ்வுகள் இயற்கையாகவே நிகழ்ந்து கொண்டிருக்கின்றன. மனிதனுடைய அறிவாற்றல் வளர்ச்சியடைந்ததன் பயனாக

பல்வேறுபட்ட இயற்கை அம்சங்களைத் தனக்கு சாதகமாக்கி பயன்பெற முயற்சிக்கின்றான். அந்தவகையில் தான் “ஆதாம் பால” அமைப்பை ஊடறுத்து கப்பற் பாதைகளை அமைத்து பொருளாதார வளர்ச்சியை எட்டுவதற்கு விரும்பப்படுகின்றது. அந்த வகையில் தான் இந்தியாவும் இலங்கையும் “ஆதாம்பாலம்” பகுதியை பொருளாதார தேவை கருதி பயன்படுத்தத் திட்டமிடுகின்றது.

சேது சமுத்திரத்தால் முக்கியத்துவம் பெறும் தனுஷ்கோடி - தலைமன்னார் கிடையேயுள்ள ஆதாம்பாலம்

இந்தியாவின் கிழக்குக் கடற் பகுதியை மேற்குக் கரைப் பகுதியுடன் இணைக்கும் ஒரு திட்டமே சேது சமுத்திரத்திட்டம் இத்திட்டத்தின் அடிப்

படை நோக்கம் மன்னார்வளை குடாவையும் பாக்கு நீரிணையையும் இணைப்பதாகும். தலைமன்னார் - இராமேஸ்வரம் கடற்பாலம் போன்ற திட்டங்களை ஆதாம்பால மணந்திடர்களை மையப்படுத்தி (சேது சமுத்திரத் திட்டம்) செயற்படுத்த இருப்பதனால் இன்று உலக அரங்கில் கவனத்தை யீர்ந்த ஓர் புவியியல் அமைப்பாக விளங்குகின்றது.

இத்திட்டங்களின் மூலம் கடல் வழிப்பயணப் பாதைகளின் தூரம் பெரிதும் குறைவடைகின்றது. இந்தியாவின் கன்னியாகுமரியில் இருந்து சென்னைக்கு இடையிலான தூரம் 1400 கி.மீ. ஆகும். இத்தூரம் இத்திட்டத்தினால் 745 கி.மீ. ஆகக் குறைந்து விடும். பயணத்தூரம் குறைவதை அட்டவணை காட்டுகின்றது.

	குறைமுகம்	தற்போதைய தூரம்	திட்டத்தின்பின் தூரம்
கன்னியாகுமரிப் பகுதியிலிருந்து	சென்னை	1400 Km	745 km
	விசாகப்பட்டணம்	1878 km	1332 km
	கொல்கத்தா	2513 km	2034 km
தூத்துக்குடியிலிருந்து	சென்னை	1424 km	658 km
	விசாகப்பட்டணம்	1904 km	1260 km
	கொல்கத்தா	2539 km	1909 km

பயணத்தூரம் குறைவதால். எரிபொருள் சிக்கனம், பயண நேரம் குறைவு, தமிழ்நாட்டின் துறைமுகங்களின் விருத்தி, தொழில் துறைகளில் விருத்தி போன்றவை இந்தியாவைப் பொறுத்த வரையிலான பொருளாதார நன்மைகள்.

இலங்கையைப் பொறுத்த வரையில் வடபகுதி துறைமுகங்கள் விருத்தியடைய வாய்ப்புண்டு (காங்கேசன் துறை). பாம்பன் பாலம்,

அடம்பன் பாலம், தலைமன்னார் ஊடாக தரைப்போக்குவரத்து விருத்தியடையும் பொழுது இருபக்க வர்த்தகம், மற்றும் கல்வி, கலாசாரம், மருத்துவம், தொழில்நுட்பம் போன்ற துறைகளிலும் எமது நாட்டுக்கு நன்மை கிடைக்கலாம். அத்துடன் கப்பற்பாதைகள் விருத்தியடைவதனால் சுற்றுப் புறச் சூழல் அச்சுறுத்தல்களும் ஏற்படும் சாத்தியங்களும் இருக்கவே செய்கின்றன. (எண்ணெய் கழிவுகள், கசிவுகள், கடற்குழலைப் பாதிக்கும்.

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