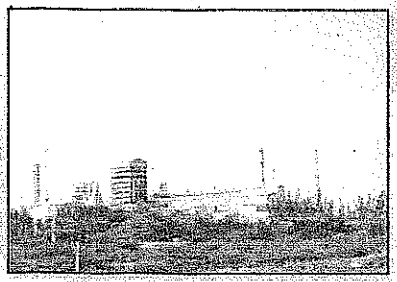
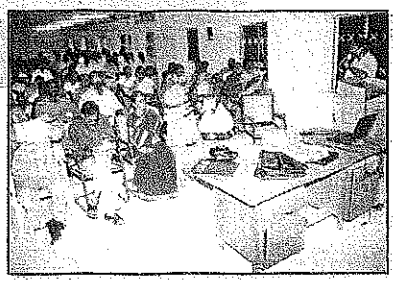
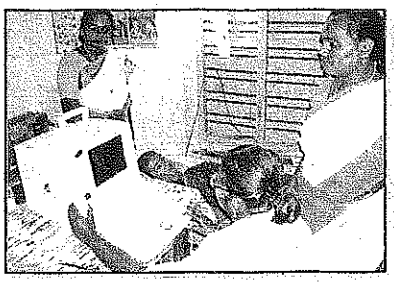
Health Status and Epidemiological Study Around 5 km Radius of Sterlite Industries (India) Limited, Thoothukudi


DEPARTMENT OF COMMUNITY MEDICINE
TIRUNELVELI MEDICAL COLLEGE
Tirunelveli - 627 001.

Preface

Community Medicine Department of Tirunelveli Medical College, Tirunelveli carried out the Health Status and Epidemiological study around 5 km radius of SIIL, Thoothukudi District in 2006-2007.

Directorate of Public Health and Preventive Medicine, Govt.of Tamil Nadu, Chennai has granted the permission for the study.

Since this study was related to health status of the people, it needed technically qualified, skilled and experienced staff. Consultancy from experts in different National institutions and retired Directors of Public Health were obtained for this study.

Initially this study was planned to complete it within a period of 6 months but while doing the study many areas were to be explored and the period was extended. In addition, additional comparative study area had also been undertaken in Ramanathapuram district. So the period has extended from 6 months to one year.

This study brings about the information on the health status of the people at the time of the study around 5 km radius of the SIIL, Thoothukodi. In addition, this study report consists of the morbidity, mortality with a comparison of control areas I, II and state.

This study was possible because of the active participation of the people in the area, Doctors and CRRIS of Tirunelveli Medical College, Doctors and Para-Medical staff of Thoothukudi and Kovilpatti Health Unit Districts and specialists from Thoothukudi Medical College. Methodex System, Chennai has been involved in formatting the survey and analysis of the data.

I would like to thank Dr. P. Krishnamurthy, Director of Public Health and Preventive Medicine (Rtd) and Dr. G.M. Venkatakumar, Officer on Special Duty in the cadre of Director of Public Health and Preventive Medicine (Rtd) who were instrumental to carry out the survey. I am also thankful to Dr. A. Liaquat Ali, Deputy Director of Health Services (Rtd) Thoothukudi, Dr. Selvakumari, Deputy Director of Health Services, Kovilpatti and Dr. D. Saraswathy , Dean (Rtd), Tirunelveli Medical College for their constant support to carry out the survey. I am very much thankful to Mr.Arumugam, Retired Lecturer in Statistics, Tirunelveli Medical College for his contribution in designing and analyzing the data.

I would like to acknowledge the help rendered by Mr.S.Raju, Microbiologist, office of the Director of Public Health and Preventive Medicine, Chennai and Mr.G.Ekambaram, Personal Clerk to Additional Director (M&F) for their assistance in compilation, typing and formatting the report.

I will fail in my duty if I don't place my gratitude in record to SIIL, Thoothukudi for the opportunity given to carry out this herculean task.

Place : Thoothukudi
Date : Oct. 2008

Dr. S. ELANGO
Principal Investigator

List of Abbreviations

AAQ	-	Ambient Air Quality
AC	-	Air-conditioner
BDL	-	Below Detectable Level
BIS	-	Bureau of Indian Standards
BMI	-	Body Mass Index
CO	-	Carbon Monoxide
CPCB	-	Central Pollution Control Board
CRRI	-	Compulsory Residential Rotatory Internship
CU	-	Consumption Unit
CWA	-	Chief Water Analyst
DCDA	-	Double Conversion Double Absorption
DDHS	-	Deputy Director of Health Services
DPH	-	Director of Public Health
ECG	-	Electro cardiogram
GH	-	Government Hospital
GLV	-	Green Leafy Vegetables
HH	-	House Hold
HSC	-	Health Sub Centre
HUD	-	Health Unit District
HVS	-	Hygiene Ventilation System
IAP	-	Indian Association of Paediatrics
ICD	-	International Classification of Diseases
ICDS	-	Integrated Child Development Scheme
ICMR	-	Indian Council of Medical Research
IEA	-	International Epidemiological Association
IPHA	-	Indian Public Health Association
ISM	-	Indian System of Medicine
KIPM	-	King Institute of Preventive Medicine
LPG	-	Liquid Petroleum Gas

NAAQ	-	National Ambient Air Quality
NCHS	-	National Child Health Survey
NFHS	-	National Family Health Survey
NGO	-	Non Governmental Organisation
NIN	-	National Institute of Nutrition
NPNL	-	Non-Pregnant Non-Lactating
PGs	-	Post Graduates
PHC	-	Primary Health Centre
RCC	-	Reinforce Cement Concrete
RDH	-	Recommended Doses of Vit A
RDI	-	Recommended Dietary Intake
RHP	-	Rotary Holding Furnace
RPM	-	Respirable Particulate Matter
SD	-	Standard Deviation
SE	-	Standard Error
SIIL	-	Sterlite Industries (India) Ltd
SIPCOT	-	Small Scale Industries Promotion Council of TamilNadu
SPIC	-	Southern Petro Chemical Industries
SS	-	Stainless Steel
TAC	-	Tuticorin Alkaline Chemicals
TNPCB	-	Tamil Nadu Pollution Control Board
TSPM	-	Total Suspended Particulate Matter
TV	-	Television
UG	-	Under Graduate
VBDC	-	Vector Borne Disease Control
WHO	-	World Health Organisation
WHRB	-	Waste Heat Recovery Boiler

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  Public Health Specialist, All India Institute of Hygiene and Public Health, Kolkata

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- **Dr.Selvakumari,**
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  Dean (Retd.), Tirunelveli Medical College

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1. Introduction

India's ongoing industrialization has placed great strain on the country's environment and health. This rapidly growing population, urbanization and industrialization, has placed significant pressure on environmental issues related to pollution of water, soil and air causing ill effects on the health of the human being.

Rapid industrialization in many countries has greatly increased soil, air and water pollution. Vehicle exhaust, fossil fuel burning and smoke from factories form small particles in the air that cause serious health damage. Discharges from the industries causes soil and water pollution. More than 2.7 million people every year die from respiratory illness, heart diseases and cancer due to air pollution. Besides harming human health, pollution causes direct economic losses. Germany loses an estimated $4.7 billion in agricultural production every year as a result of pollution; Poland $2 billion, Italy $1.8 billion and Sweden $ 1.5 billion are other countries which lose production. Polluted air drifts across national frontiers. Heavy metals and chemicals discharged either in the soil or in the water course pollute the soil and water. High levels of arsenic and lead in West Bengal caused serious health problems of the people. In Tamilnadu discharges from tanning industries in Vaniampadi, Trichy and Dindigul districts made the fertile agricultural lands in to infertile and unfit for cultivation. The foul odour stopped the growth and development in the area. Skin and respiratory diseases are high in the area.

World Health Organisation has defined Health is a "State of physical, mental and social well being and not merely an absence of disease or infirmity". The WHO definition is considered as an idealistic goal than a realistic proposition. It refers to a situation that may exist in one individual but not in every one all the time. In recent years the new philosophy of health is that the health is a **"fundamental human right"**, essence of productive life, integral part of development, intersectoral, central concept of quality of life. Its maintenance is a social investment. World wide it is a social goal. Finally, it involves individuals, state (governments), community and international responsibility.

As per the above definition, the health status of the individual is in a continuous process of change and adjustments depending on the epidemiological triad i.e., agent factors, host factors and environmental factors. This study explores the possibility of obvious and hidden environmental factors which influence the health of the people in the area and If there is any factor and to measure its probability.

As per the guidance of International Epidemiological Association (IEA), the epidemiological part of this study dealt the distribution and magnitude of the health problems in the area, to identify the factors responsible for the problems and to provide data for planning, prevention, control and treatment of the diseases besides some recommendations.

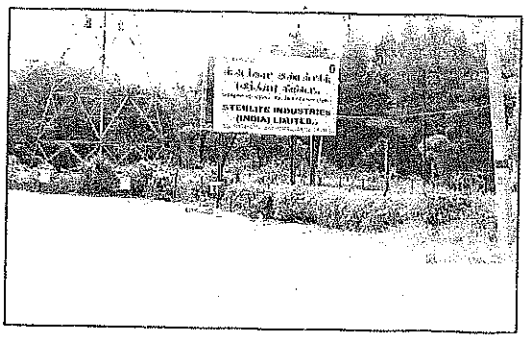
For sake of completion of the survey and as a part of programme in the study, medical camps were organized and treatment facilities were made available to the public.

Finally, it is highlighted that Health is multifactorial and many factors influence the health of the individual both within individuals and externally in the society in which he lives.

So, the determinants of the Health Status include Biological determinants, Behavioral and Socioeconomic conditions, Environmental factors and Health Services. Therefore environmental factors alone cannot be singled out for the health status of the people in the area.

Keeping the above points in mind and the past scenarios, the Professor of Community Medicine, Tirunelveli Medical College has been requested by the Directorate of Public Health and Preventive Medicine to carry out an Epidemiological and Health Status study around 5 km radius of the SIIL, Thoothukudi.

The study was carried out successfully and the report is submitted for follow up action.



2. Company Profile

2.1 Background

Sterlite Industries (India) Ltd (SIIL) is a group of company of Vedanta Resources Plc. Vedanta was listed in London in December 2003. Vedanta is a diversified and integrated FTSE 250 metals and mining group. The principal operations are located in India, where they have a major market share in each of main metals like aluminum, copper, zinc, lead and iron ore exporting. There are also substantial copper operations in Zambia and a copper mine in Australia.

Sterlite Industries (India) Ltd., at Thoothukudi has the following production units within their premises:

1. Copper smelter & Copper Refinery
2. Gas cleaning and Sulphuric acid Plant
3. Phosphoric acid Plant
4. Copper Rod Plant
5. Captive Power Plant.

The copper business in India is held within Sterlite Industries (India) Ltd (SIIL). There is some captive copper mining in Australia, but the business in India is principally in smelting and refining. Sterlite produces finished copper in the form of cathode, some of which is then converted to copper rod. The initial process is carried out at the smelter, based at Thoothukkudi in Southern India, and there are refineries and copper rod plants at Thoothukkudi and Silvassa, in Western India.

This plant was established in 1996 and commissioned for commercial production in 1997. The copper smelter plant of SIIL has the following production capacity during the study period.

Table 2.1 SIIL Products and Production

S.No.	Products	Quantity (Tonnes per day)
1	**Main Products:**	
	1.1 Copper Anodes	1200
	1.2 Copper Cathodes	875
	1.3 Phosphoric Acid	800
2	**Intermediate Products:**	
	2.1 Anode Slime(refinery)	1.75
3	**By Products:**	
	3.1.Sulphuric Acid	4200
	3.2 Hydro fluro silicic Acid	25

Significance of the Project

Copper application areas cover different disciplines like, Architectural, Electrical, Automotive, Tube, Pipe, Fuel gas, Industrial, Marine and Machine products which gives a great demand for copper

2.2 Description of the Plant Site

The plant is located in SIPCOT industrial estate, Thoothukudi with an extent of 194.78-ha (Existing land - 102 ha; 92.47-ha of land is in acquisition process and SIPCOT is yet to handover). The nearest village to plant is Terku Veerapandiya Puram (T.V. Puram), which is about 1.5-km on North West direction. The average elevation of the plant site is about 20-m above MSL. Thoothukudi is well connected by sea, road and air to all remaining parts of the world, which is most helpful for the bulk cargo logistics industries. The location map and study area radius of the plant is shown in Figure-2.1 and Figure-2.2 respectively.

Environmental Setting of the Plant Site

The environmental setting of the plant site is given in Table-2.2

Table - 2.2 Environmental Setting of the Plant Site

S.No.	Particulars	Details
1	Latitude	8^0 40' N - 8^0 55' N
2	Longitude	77^0 55' E - 77^0 10' E
3	Elevation above MSL	20-m above Mean Sea Level
4	Climatic conditions	As per IMD Thoothukkudi: Annual Mean Max Temp : 38.3° C Annual Mean Min Temp : 19.4° C Average Annual Total Rainfall : 625.8 mm
5	Present land use	Industrial Area
6	Nearest Highway	NH-45B Connecting Madurai and Thoothukkudi (1.5-km,SE)
7	Nearest Railway Station	Milavittan (1.0-km, SE)
8	Nearest Airport	Vaagaikulam (12-km, W)
9	Nearest Town/City	Thoothukkudi (7.4-km, ESE)
10	Hills/valleys	Nil within 10-km radius
11	Archaeologically important places	Nil within 10-km radius
12	National Parks/ Wildlife Sanctuaries	Nil within 10-km radius; Gulf of Mannar National Park (14-km, E)
13	Reserved / Protected Forest	Nil within 10-km radius
14	Seismicity	Zone-II
15	Streams/Rivers	No major rivers within 15-km radius
16	Defence Installations	Nil within 15-km radius
17	Port	Thoothukudi Port (17-km)
18	List of Industries within 7-km radius	Enclosed in Annexure VII and VIII

Figure-2.1 Location Map of the Plant

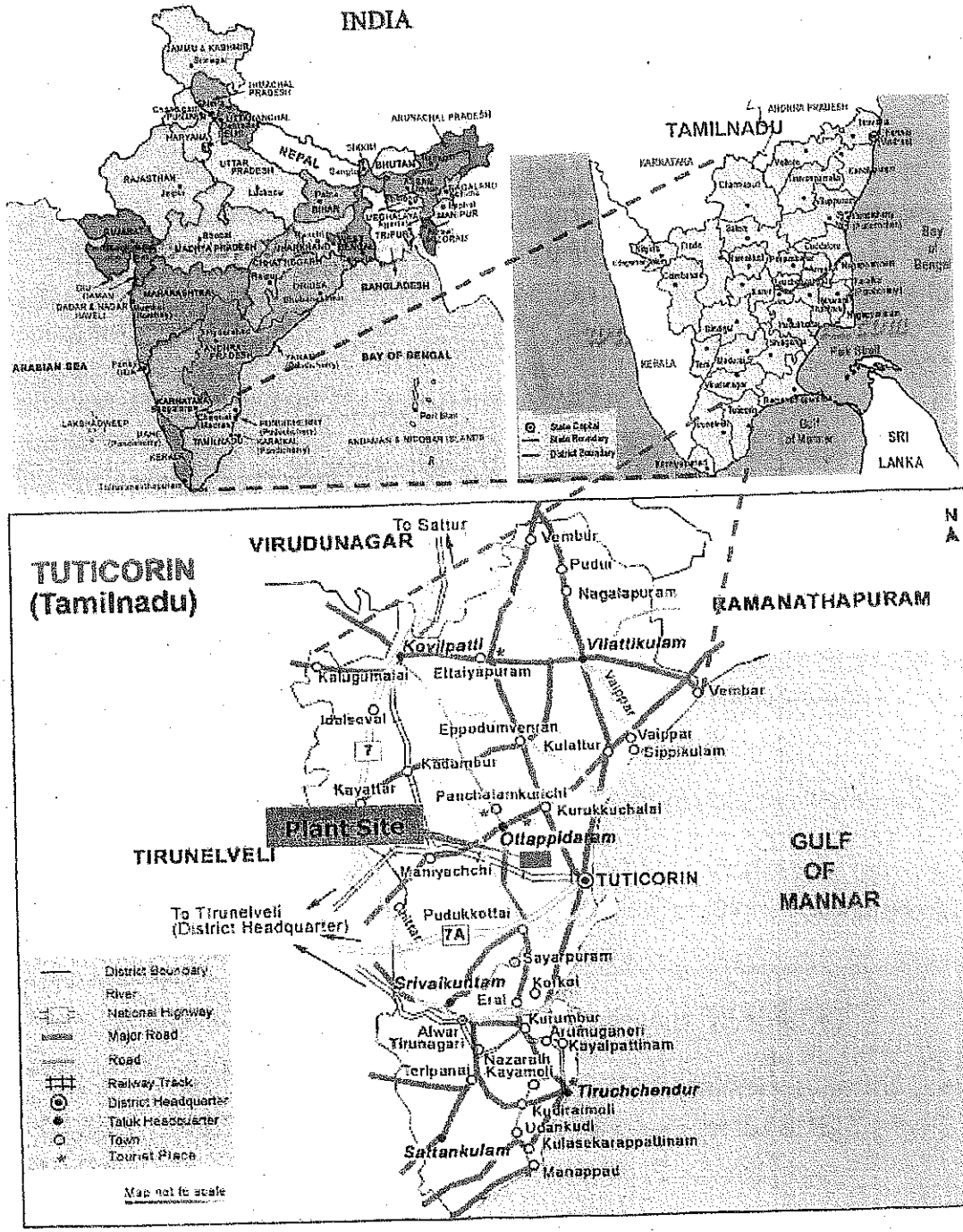
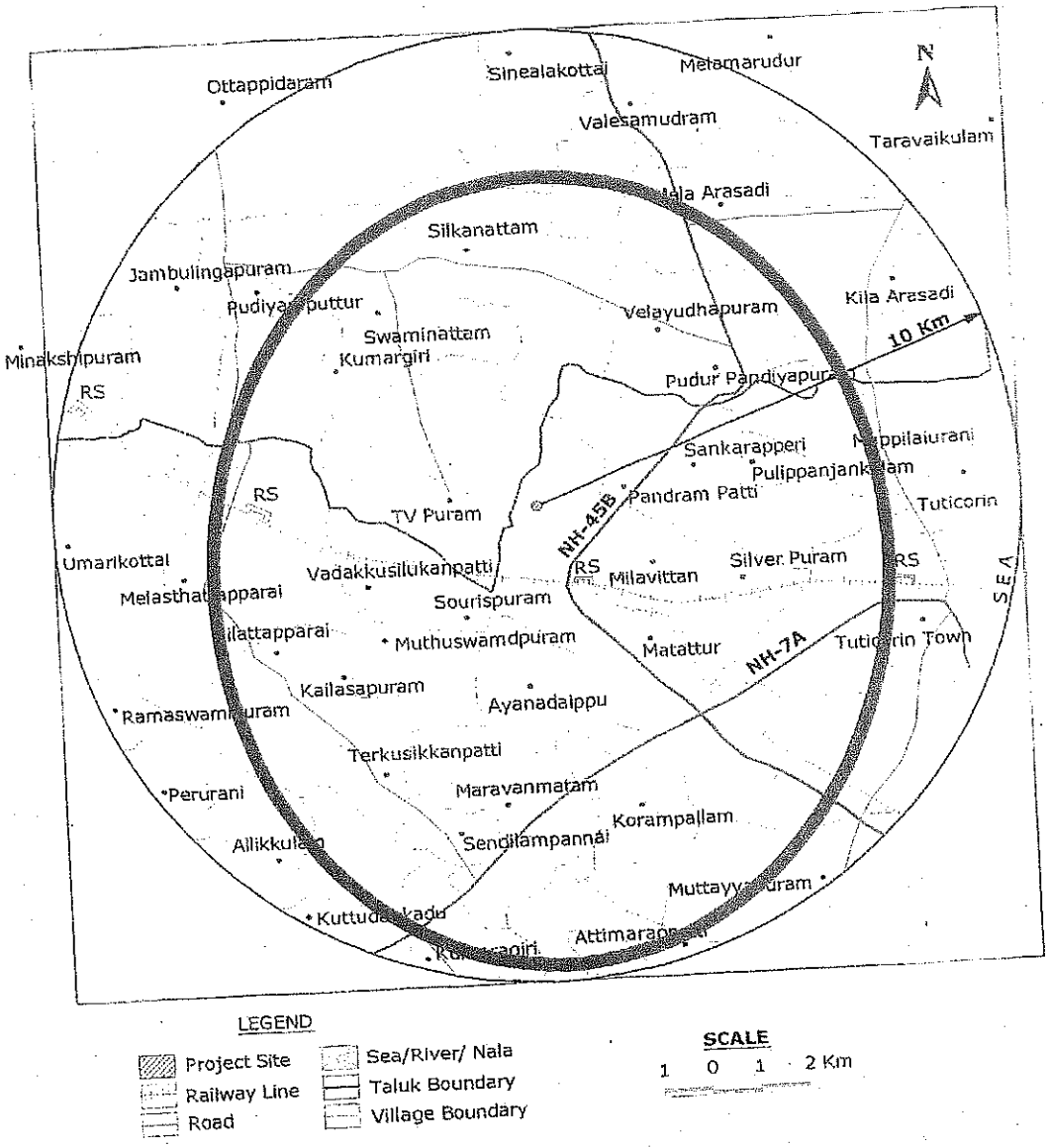


Figure - 2.2 Study Area Map (Marked as ◯)



2.3 Copper Smelter Plant

Process Description

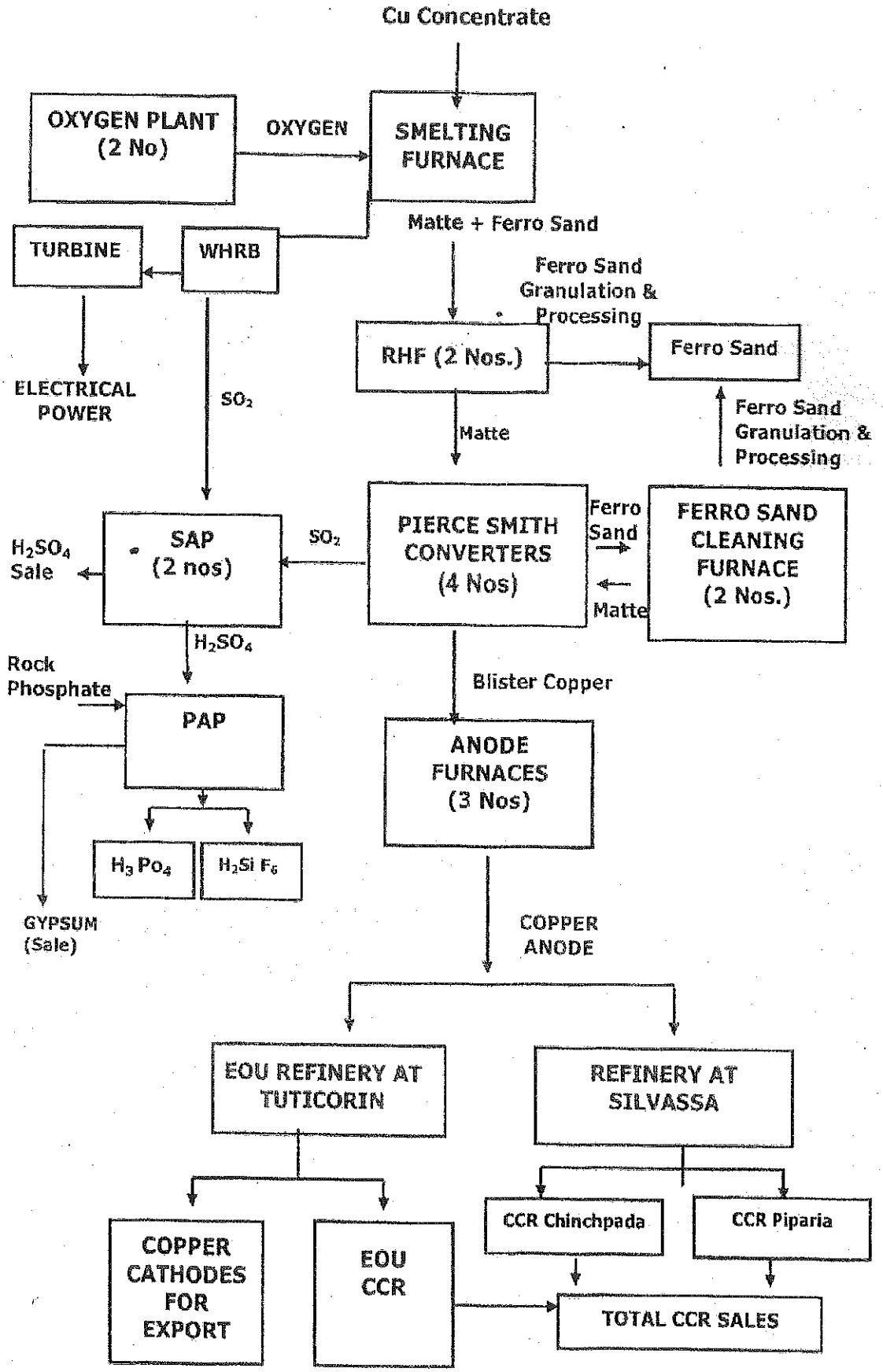
The copper anodes are produced from the imported copper concentrate through pyro-metallurgical (smelting) processes. The sulphur dioxide generated during the smelting of copper is converted into sulphuric acid by the well-known Double Conversion Double Absorption (DCDA) process. A part of this sulphuric acid is captively utilized for production of phosphoric acid from the imported rock phosphate using a Hemi-hydrate-Di-hydrate process. The casted copper anodes are dispatched to the refinery unit for further electrolytic refining to about 99.99% purity, which is necessary to obtain the required electrical conductivity for electrical applications.

The principal raw material for the production of copper metal at SIIL is a sulphidic copper concentrate containing about 25-35% copper, 28-32% sulphur, 25-30% iron and 7-10% moisture. The process flow diagram of copper smelter plant is shown in Figure-2.3. The major steps in copper extraction include:

- Blending of different grades of concentrates;
- Smelting of concentrate in ISASMELT furnace to produce an intermediate copper rich product known as 'matte' containing 50-65% copper and eliminate iron as iron silicate (Ferro Sand) by adding silica;
- Converting liquid matte to blister copper (98-99% Cu) in a Pierce-Smith converters (PS converter);
- Fire refining of blister copper to produce anode copper (99.5% Cu) in anode furnace and casting of the anodes; and
- Electrolytic refining of anodes to produce copper cathodes (99.99% Cu).

In the process of extraction of copper metal from sulphidic concentrates, sulphuric acid is recovered as a by-product from the sulphur dioxide emanating from the ISASMELT and PS converting furnaces.

Figure 2.3 Process Flow Diagram of Copper Smelter Plant



Brief Process Description - Smelter Plant

ISASMELT is a recently developed, novel pyro-metallurgical bath smelting process for the extraction of copper from its sulphidic concentrates. The process comprises of smelting the sulphidic copper concentrate in a vertical cylindrical, refractory brick lined, flat roofed furnace vessel. A central lance injects air, oxygen and fuel into a molten bath of ferro sand and the matte. The blast of oxygen enriched air and fuel down the lance violently stirs the liquid vigorously. These lances are the proprietary supply of the technology supplier. These lances are a 'pipe within pipe' assembly. They are constructed from a composite of stainless and mild steel and incorporate specially designed helical gas swivel that enables the use of low-pressure air and oxygen. Controlled swiveling of the process gases inside the lance cools the outer section sufficiently to solidify a layer of ferro sand around the outer surface of the lance. This provides a protective coating in the highly aggressive bath environment.

The lance goes through the top of the furnace into the bath and the SO_2 off gases from the furnace pass up through an uptake shaft to a gas cooler / waste heat recovery boiler (WHRB) and the cooled gases pass through an electrostatic precipitator for the removal of the dust before the gases are conveyed to the sulphuric acid plant.

The products of the ISASMELT process, matte and ferro sand are tapped periodically from the bottom of the furnace through a water-cooled copper tap hole. The matte and ferro sand then flow into a Rotary Holding Furnace (RHF) where the matte separates from the ferro sand. The ferro sand from the rotary holding furnace / Ferro sand cleaning furnace is granulated in a dedicated ferro sand granulation system and the granulated ferro sand is discarded to a place inside the smelter plot.

The matte (65±3% Cu) is conveyed through ladles to Pierce Smith (PS) Converters for conversion to blister copper. The SO_2 off gases from the PS converter is treated in an ESP for the removal of residual dust before being led to acid plant for the production of sulphuric acid.

The blister copper is further treated in anode furnaces for fire refining and cast into anodes for electro-refining in an ISA REFINERY to a saleable copper cathode of 99.99% Cu purity.

Operational Theory of Smelter

The charge is selectively oxidized in the bath of the ISASMELT furnace in such a way to liberate part of SO_2 and the exothermic heat of reactions is used inside the furnace to raise the temperature of the constituents above their melting point. The instantaneous smelting reaction forms molten mass of Cu_2S, FeS, FeO and Fe_3O_4. Further reaction takes place in the molten mass where FeO reacts with the silica in the charge to form ferro sand. Two separate liquid phases are formed in the rotary holding furnace/ electric furnace;

After the removal of iron ferro sand by ferro sand granulation, molten matte from the RHF /Ferro sand cleaning furnace containing about 65±3% copper is tapped from the RHF / FCF furnace at about 1220°C in ladles and six ladles of 10-m^3 are transferred by means of EOT

crane to the Pierce-Smith converter. In converter, air is blown to the liquid matte at 150 kPa pressure through side-blown tuyeres, and quartz added as a flux in three stages results in production of the blister copper. The operation of converter is autogenous and exothermic; the heat of reactions is more than sufficient to maintain the operating temperatures. The products from converter are blister copper (about 98.5% Cu) and ferro sand (approx. 7-10% Cu).

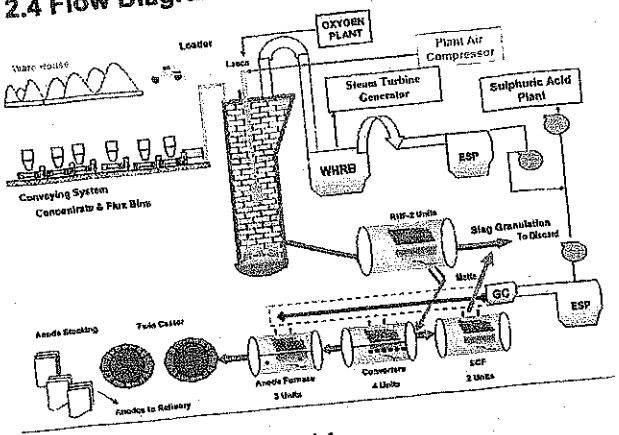
The ferro sand from the converters is cleaned in a Ferro Sand Cleaning furnace for reducing copper in ferro sand below 0.5% of Cu. The ferro sand is allowed to settle in Ferro sand cleaning furnace where again two layers of molten matte and ferro sand is formed. Matte from Ferro sand cleaning furnace is treated in converters whereas ferro sand is tapped, granulated and discarded.

The off gases from ISASMELT furnace and converters after cleaning and cooling are utilized for the production of sulphuric acid. Blister copper poured from converter to ladles is transferred to anode furnaces by means of EOT cranes for further fire refining. Controlled air blow first oxidizes remaining sulphur to remove as sulphur dioxide. However in the process, part of copper is also oxidized, which is reduced back by reduction with hydrocarbons available from cracking of LPG. The fire-refined copper containing about 99.7% Cu is poured on rotating anode casting twin wheel as anodes each weighing about 375-kg. The anodes are dispatched to tank house for electro-refining.

Hygiene Ventilation System

A provision has also been kept to collect fugitive secondary gases arising from ISA Furnace, Rotary Holding Furnace, Ferro Sand Cleaning Furnace, Converter Furnace an Anode furnace operations and is being treated in Hygiene Ventilation System. The fugitiv emissions from ISA, and RHF (such as the feed port, tapping port), SCF charging por Converter Secondary and Anode Furnace oxidation chamber are captured through hoo arrangements and are scrubbed in the ISA/RHF Hygiene Ventilation Systems (HVS) a Conv/AF Secondary gas Hygiene ventilations systems. The HVS consists of vent scrubbers and demister arrangements. Milk of Lime is used as a reagent for scrubbing t secondary gases. The scrubbed gases, free of SO_2 except for some traces are vented throu a stack.

Figure 2.4 Flow Diagram of ISA Melter and Rotary Furnace



Brief Process Description - Electrolytic Refinery

The anodes cast in the smelter section are electro refined in electrolytic cell to produce cathodes based on the process technology developed at CRL, Townsville, Australia by Xstrata Technology, Australia. The process commonly known as ISA process uses permanent stainless steel electrodes as cathodes and copper anodes from Smelter as anodes in the electrolytic cells. Electrolysis of copper anodes is carried out by passing Direct Current (DC) from the rectifier. Copper ion from anode dissolves in electrolyte and gets deposited on the stainless steel cathode as sheets. The copper deposits are mechanically stripped from both sides of the stainless steel mother blanks. After stripping the S.S. mother blanks are recycled back to the electrolytic cell for subsequent use. The stripped copper deposits form the 99.99% pure Copper production from Cell house. One anode cycle lasts nearly three weeks and three cathode crops are drawn at weekly intervals.

The anodes after receipt from smelter are unloaded on to the feed conveyor of the anode preparation machine. The machine accepts good anodes and rejects bad anodes on weight basis. The anodes are pressed to straighten and lugs are milled in the machine for ensuring better electrical contacts. Prepared anodes are discharged on to separate spacing conveyors with desired spacing for loading into the electrolytic cells by tank house overhead cranes.

The anodes (56 Nos.) and stainless steel cathodes (55 Nos.) are placed in each electrolytic cell with a pitch of 100 mm, arranged in 24 sections of 24 cells each filled with electrolyte, with a composition of 42-44 gm/liter Cu and 180 gm/liter H_2SO_4. The electrolysis of copper anode is carried out by applying a current density applied is 310 Amp/m^2 of cathode surface. The electrolyte in the cells is circulated continuously at 65°C to facilitate the nodular free uniform deposit of copper on cathode. The electrolyte is pumped from a circulation-collecting tank to an overhead tank through a heat exchanger. From the head tank, the electrolyte flows down under gravity to feed each cell at the rate of 25-30 liter/minute. The electrolyte enters the cell at bottom and leaves from the top ensuring the flow of the electrolyte throughout the cell. The return from the cells flows to circulation tank, through a mist eliminator. Additive reagents like Gelatine or Glue, Thio urea, HCl, etc are added to circulating electrolyte to improve the quality of the cathode deposit. To arrest the floating slime in the electrolyte, a polishing filter continuously filters around 30% of the electrolyte in circulation.

The cathodes are harvested on a seven day cycle, constituting three cathode crops out of each anode cycle of 21 days. At the end of each harvest of 7 days, the cathodes are pulled out of the electrolyte cells. During this pulling time the entire block of cells is by passed from the main electrical circuit by means of electrical shunt and switch system. The 55 nos. of cathodes are lifted from the each cell by lifting bail attached to an overhead crane and transported to the cathode-stripping machine. In stripping machine, the cathodes are washed by high-pressure jet water in washing chamber. After washing the cathodes are flexed to release the copper deposits from the SS cathodes (Mother blanks). The deposited copper mass is stripped off from the blanks as copper cathode sheets and stacked one over other. The copper cathode sheets are stacked to a predetermined bundle size; it is further conveyed to next station for weighing.

The stripped mother blanks are advanced to the discharge conveyor and spaced at the desired pitch. The set of mother blanks, each consisting of 55 blanks, are lifted by lifting bail of overhead crane to place into electrolyte cells for start of new cathode cycle.

At the end of anode cycle, the anode scrap weighing around 50 kg each is removed from the cells by over head crane and placed in the feed conveyor of Anode Scrap Washing Machine, for washing of anode slimes from the anode scrap. The washed scrap anodes are recycled back to smelter.

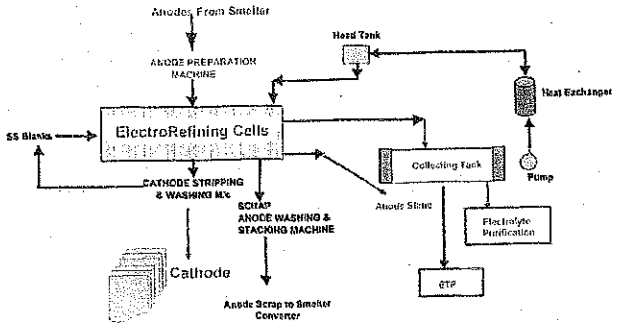
The insoluble part of anodes, which consists of copper and precious metals settle down at the bottom of cells as anode slime during electro refining. After each anode cycle of 21 days, the electrolyte cells are washed with water and the anode slimes are collected in the slime storage tank.

In slime treatment plant, anode slime containing approximately 35% Cu, is treated with sulphuric acid at elevated temperature to reduce copper content. After leaching operation, the copper free slimes are filtered and treated further for separation of nickel, selenium and tellurium. Finally, purified slime will be exported for recovering precious metals, like silver and gold from the filtrate, tellurium is precipitated by cementation and tellurium free solution returned to electrolyte purification circuit.

During refining process, copper dissolves in electrolyte and impurities like nickel, arsenic, antimony, bismuth, and selenium etc., also go into the solution. For the production of the good quality cathode the impurities level in electrolyte should be as low as possible and the copper content in the electrolyte required to be maintained at the desired value. This is achieved by withdrawing a small portion of electrolyte from the electrolyte circulation system as a continuous bleed. The electrolyte bleed stream is treated in purification plant where in liberator cells electro winning of copper from electrolyte reduce the copper content. A portion of the treated electrolyte is recycled back to main circulation system and some portion is sent to ETP for final treatment. During electro winning in liberator cells, arsenic, antimony, bismuth are precipitated and collected as a copper arsenic sludge for disposal.

The cathode produced from the refinery is charged in Continuous Copper Rod plant. These cathodes are remelted and drawn as continuous copper rods, the same is being exported from Thoothukudi.

Figure 2.5 Flow Diagram of Electrolytic Refinery Process



2.4 Gas cleaning and Sulphuric Acid Plant - Brief Process Description

The sulphur dioxide gases generated during the sulphidic copper concentrate smelting in ISA and matte converting operation in PS converter of copper smelter plant are treated in sulphuric acid plant for the production of monohydrate sulphuric acid as a byproduct. The process of production of sulphuric acid consists of three principal steps:

- Cleaning of the sulphur dioxide gas from the ISASMELT furnace and PS converters;
- Catalytic conversion of the sulphur dioxide (SO_2) gas to sulphur trioxide (SO_3) gas according to the chemical reaction:

  $SO_2 + ½ O_2 \Longleftrightarrow (SO_3)$

- Absorption of the sulphur trioxide (SO_3) gas by combining with water (H_2O) to form sulphuric acid (H_2SO_4).

The conversion of SO_2 to SO_3 is an exothermic, reversible and adiabatic reaction and with increase in temperature the equilibrium constants become more unfavorable with respect to SO_3 formations. The other factors, which favour equilibrium conversions, are increase in oxygen concentration in the gases and or high pressures but the relative gains are rather small. In contrast to the unfavorable effect of high temperature on equilibrium it is found that the rate of reaction increases rapidly with rising temperature. Consequently, optimum performance requires a balance between the opposing effects of reaction rate and equilibrium. Thus, the gases entering the V_2O_5 catalyst normally are maintained between 400 - 450°C. Therefore, in order to achieve over-all high conversion efficiencies between 99.6% - 99.7%, it is imperative that the converter gases need to be cooled between stages to the above temperature range and also removing the partially converted sulphur trioxide formed normally after 2nd/3rd beds, before returning them to subsequent stages. This process is commonly known as Double Conversion and Double Absorption (DCDA).

Purification of SO_2 Gas

The SO_2 gas from the smelter and PS converters contains metallic dust, fume, acid mist, water vapour and various other impurities like halides etc., which are not only detrimental to the catalyst used for conversion in the sulphuric acid production but also contaminate the product. The gases are therefore cooled, cleaned in the gas cleaning plant comprising of gas cooling tower, Dynawave Scrubbing System, and wet electrostatic precipitators. A portion of the weak acid from circulation system of the scrubbers is continuously bled, which is predominately consists of the halides like, fluoride, chlorides etc., to the effluent treatment plant. The wet gas precipitator electrically removes the acid mists formed during the downstream operations and optically fully saturated SO_2 bearing gases are conveyed to the sulphuric acid plant.

Drying, Conversion and Absorption of SO2 to SO3

The optically cleaned SO_2 rich gases along with dilution air to the extent required for maintaining the requisite O_2 /SO_2 ratio are dried in a drying tower with 96% concentrated sulphuric acid in counter current circulation. The dried gases after heating to 400-450 °C passed through converter with cesium promoted vanadium pent oxide catalyst. The converted SO_3 gases are absorbed in two absorption towers via DCDA Process, where 98% concentrated sulphuric acid is circulated to produce 98.5% strength Sulphuric acid product.

Tail Gas Scrubbing Facilities

The sulphuric acid plant has been designed limiting the SO_2 content from the absorber unit at around 1 kg/t of 100% Monohydrate sulphuric acid; however, during the startup and other abnormal operations these values may not be able to be maintained. Therefore, the unit has provided a tail gas scrubber to absorb these gases and other mists before venting to the atmosphere through the stack.

Product Storage

The 98.5% sulphuric acid produced is pumped from the product tank to seven storage tanks. The product acid from the storage tank is loaded in acid tankers for dispatch.

Figure- 2.6 Process Flow Diagram of Gas Cleaning Plant

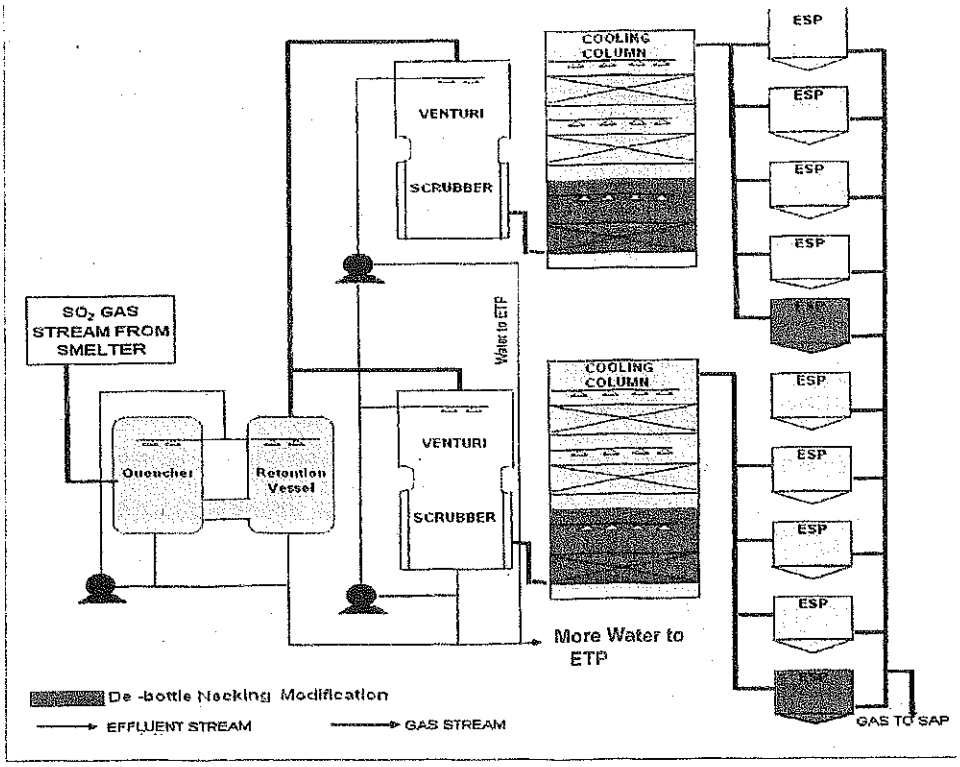
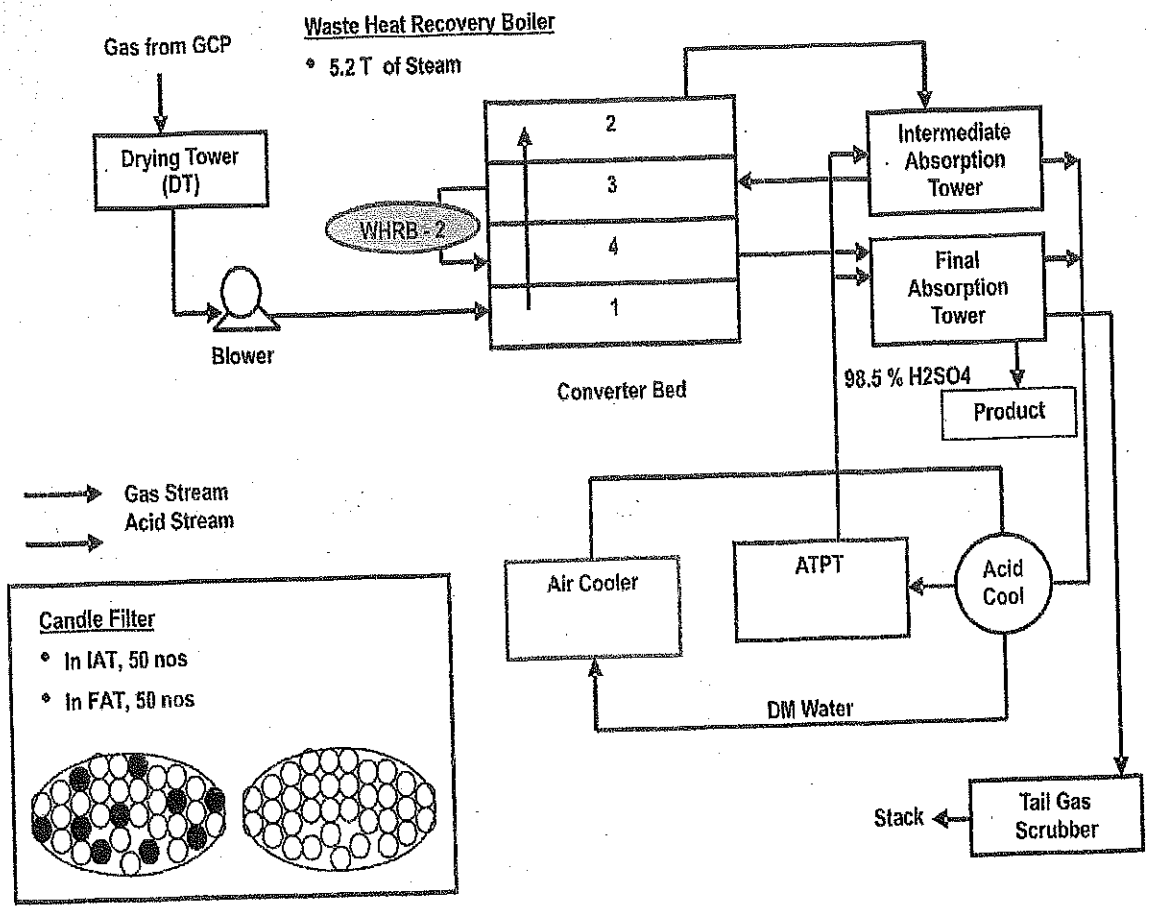


Figure 2.7 Process Flow Diagram of Suphuric Acid Plant



2.5 Phosphoric Acid Plant

Brief Process Description

The production of phosphoric acid is based on well known Hemihydrate Dihydrate process. The main raw materials for the phosphoric acid production are rock phosphate and sulphuric acid. The rock phosphate is reacted with sulphuric acid in a series of reactors to produce phosphoric acid. The solid waste (phosphogypsum) generated in the process is separated and transferred to the low / high density polyethylene lined gypsum pond through pipe conveyers. The off gas from the reaction containing hydrogen fluoride is scrubbed and converted to hydro fluro silicic acid, which is sold as a byproduct.

Rawmaterials:

The basic raw materials for all the above process is inventorized to identify the basic health hazard, if any to the surroundings due to the usage of these raw materials in the smelter operations.

Table: 2.3 Raw Materials for the plant

S.No.	Consumable Raw Material	(T/Day)
	Smelter	
1	Copper concentrate	4439
2	Furnace oil	94
3	Liquid oxygen	1084
4	Silica	789
5	Quartz	173
6	Liquid Petroleum (LPG)	30
7	High speed Diesel	3
8	Limestone	197
9	Coke	40
	Refinery	
10	Copper anodes	875
11	Hydrochloric acid	0.25
12	Thio-urea	1.5
13	Glue	1.5
	Continuous Copper Rod	
14	Copper Cathode	410
15	Caustic Soda	0.005
16	ISO Propyl Alcohol	1.6
17	Emulsion	0.009
18	Wax	0.008
19	LPG/Propane	16
	Sulphuric Acid Plant & ETP	
20	Lime	217
21	Ferric sulphate	30
22	Sodium sulphide	10
23	Flocculent	0.03
24	Sodium Hydroxide	4
	Phosphoric Acid Plant	
25	Suphuric acid	2249
26	Rock phosphate	2730
27	Active silica	31
28	Defoamer	4.0
29	Castic lye solution	1.0

2.6 Water Requirement

The total water requirement for the plant is about 12059 m^3/day. Out of this, fresh raw water requirement for entire operation of copper smelter is about 7879-m^3/day and rest is met from treated effluent water. The details of usage and water balance is presented in Table-2.4 and shown in Figure-2.8

Table-2.4 Water Requirement

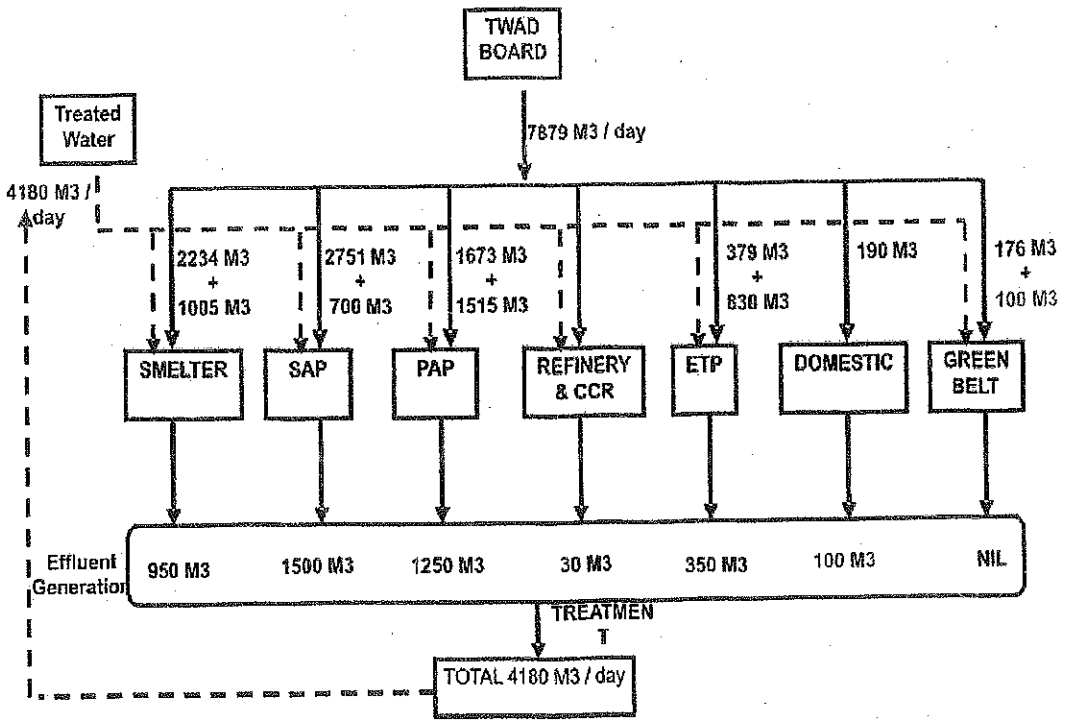
(All value are given in m3/day)

Sr. No.	Purpose	Water Consumption		Effluent Generation
		Raw (Fresh) Water	Recycled Waste Water	
1	Smelter Plant	2234	1005	950
2	Suphuric Acid Plant	2751	700	1500
3	Phosphoric Acid Plant	1673	1515	1250
4	Refinery & CCR	476	30	30
5	Effluent Treatment Plant	379	830	350
6	Domestic	190	00	100
7	Greenbelt	176	100	0

Water Balance:

This Smelter complex is practicing zero discharge from the inception of the plant. The unit water balance is detailed below in Figure 2.8. The unit is completely recycling the entire effluent in their operations back. Since there is no discharge of treated water outside, the possibility of health hazards in the study area is expected to reduce greatly.

Figure- 2.8 Water Balance

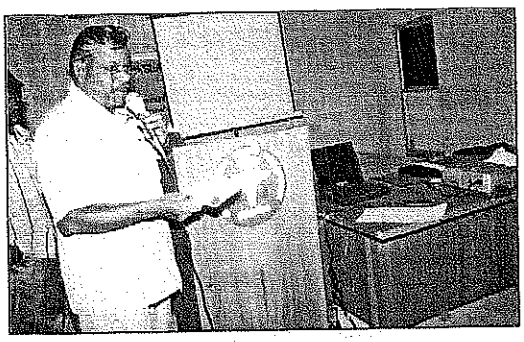


2.7 Sources of Pollution

An attempt has been made here to inventorize the sources of final emissions / discharges / solid wastes etc from the copper smelter complex. The details of process material inputs and pollution outputs for copper smelting and refining are presented in Table-2.5.

Table-2.5 Details of inputs and pollution outputs in whole copper Smelter Complex

Process	Material Input	Air Emissions	Process Wastes	Hazardous Wastes
Copper smelting	Copper concentrate, Silica flux	Sulphur dioxide	Granulated Ferro sand containing 45-50% iron, which is sold for down end uses	• Dry ESP dust, which is recycled back immediately. • Scrubber cake is stored in onsite Secured Land Fill
Copper conversion	Copper matte, Scrap copper, Silica flux	Sulphur dioxide	Granulated Ferro sand containing 45-50% iron, which is sold for down end uses	• Dry ESP dust, which is recycled back immediately. • Scrubber cake is stored in onsite Secured Land Fill
Electrolytic copper refining	Copper anode, Sulphuric acid	-	-	• ETP cake is stored in onsite Secured Land Fill
Continuous Copper Rod plant	Copper Cathode, Wax Emulsion, Isopropyl alcohol, Caustic	Sulphur dioxide, Particulate matter.	-	• Waste Emulsion
Sulphuric Acid plant and Effluent Treatment Plant	Water, Sulphur dioxide from Copper Smelting, Copper conversion	Sulphur dioxide	-	• Gas Cleaning plant effluent containing arsenic, antimony, cadmium, lead, mercury and zinc treated in ETP and the ETP Cake is stored in onsite Secured Land Fill • Spent Catalyst is stored in onsite Secured Land Fill
Phosphoric Acid Plant	Rock Phosphate	Fluorine	Gypsum	



3. Objectives

Objectives of this study

3.1. Age wise morbidity and mortality analysis in the study Area.

3.2. To study the Prevalence of respiratory, skin and eye diseases

3.3. To study the occurrence of Arsenic and other heavy metal related diseases.

3.4. Environmental pollution especially drinking water sources contamination by industrial pollutants.

3.5. To study the Health status of the people in the area

4. Methodology

4.1 Recruitmented of Staff :

This project involves collection of data from the field by visiting every house in the project area (Annexure I). For this task, experienced and well trained staffs were recruited. Different cadres of Public Health Staff who are in service and also those who are retired recently were recruited (Annexure II). For the purpose of medical camps and clinical examination of the patients, Doctors from Tirunelveli Medical College, Thoothukudi Medical College, Thoothukudi Health Unit Districts of Thoothukudi and Koilpatti and Private Practiontioners were hired.

4.2 Training:

All Medical and Para Medical staff involved in this project were given training on how to collect the data for the base line survey, organizing the medical camps, investigation of the cases, management of the patients and submission of reports etc., At every level of the survey, supervisors have been employed. Formats have been designed for the Base Line Survey, Village survey and Medical examinations by Methodox Systems, Mumbai. These formats have been field tested and corrected before the actual process of collection of data.

4.3 Phases of Survey:

This survey involves four phases.

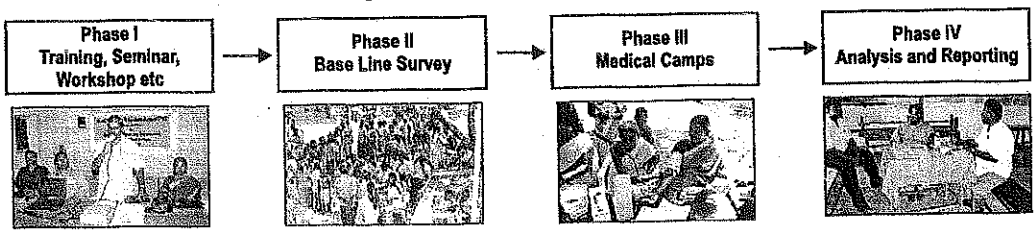
4.3.1 Phase I

In phase I, all kinds of training were imparted to all concerned through seminars and workshops. Consultancy services have been obtained from different institutions and experts in the field.

4.3.2 Phase II

In phase II, Base Line Survey (BLS) was carried out with a tested questionnaire. Experienced and trained health staffs were used for this. They went door-to-door and collected the data in the format (Annexure III). Supervisors have been engaged for each team and for each block. This ensured the quality of data collection and coverage in quantity. Supervisors are highly qualified and more experienced personnel's. They have given the verification of the 100% coverage of the households and also to clarify the doubts of the surveyors during the survey. During the Base Line Survey all data related to demography, socio-economic status and health problems were collected. One group of surveyors collected general information about the villages under survey. The village status survey includes the water supply, environmental sanitation, agriculture, solid & liquid waste management, drainage, schools, colleges, other facilities like electricity, transport and Government offices etc.,

Fig.4.1 Phases of the survey



4.3.3 Phase III

In Phase III, village level medical camps were organized. Advance intimation and informations were given by miking, distribution of pamphlets, wall posters, banners and interpersonal communications. Government and Private schools have been selected as camp sites. General MBBS doctors and specialists have been hired for conducting the medical camps. Para medical persons, who have already been involved in the survey, were engaged for mobilization and assistance. Medical examinations and investigations were carried out and treatments were given on the spot. The clinical investigations carried out, list of equipments, chemicals, reagents and kits used for the medical camps are enclosed in annexure IV to VI. The patients who need special treatment and diagnosis, were referred to private hospitals, Thoothukudi and Tirunelveli Medical College hospital for further investigation and management. This phase took a lot of time than the estimated time and schedule.

35 medical camps have been conducted in the study area and 4 camps have been conducted in Control Area I and II. (Fig.4.2.). Table 4.1 gives the number of camps, population covered, attended and beneficiaries at the time of survey.

Table 4.1 Medical Camps and Beneficiaries

No. of Camps Conducted	Population Covered	No. attended the camps	No. of beneficiaries
35	80725	51687	49729

Control Areas:

In the project proposal apart from the study area, a non- industrial control area was selected in Athoor PHC of Dindigul District. The morbidity results were analaysed and there was a vast difference in the incidence of respiratory illness especially asthmatic bronchitis in the study area and control area. There is also a significant increase in the eosinophil count of the individuals in the study area. So, in the mid course of the survey, it has been suggested by the administration to take up another control area preferably a seashore area without any industries for which Utchipuli HSC area of Ramanathapuram District was selected and the same survey was carried out. The data collected in the study area and in the Control Area I and II are tabulated and analysed in Table 5.1 to 5.30 and Fig 5.1 to 5.29.

Fig 4.2 Map Showing Study area, Control Area I and Control Area II

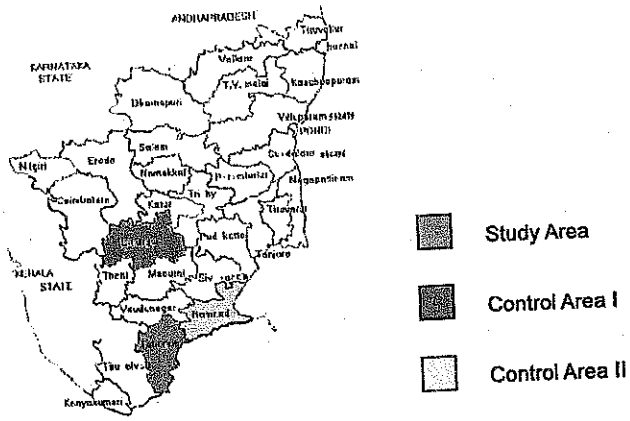


Table 4.2 Medical Camps in Control Area I (Athoor PHC, Dindugul Distr

No. of Camps Conducted	Population Covered	No. attended the camps	No. benefic
2	5164	2121	205

Table 4.3 Medical Camps in Control Area II (Utchipuli HSC, Ramanthapuram

No. of Camps Conducted	Population Covered	No. attended the camps	No. benefi
2	4897	1876	17

Sampling Method:

Total population of the study area was stratified with commonest importa such as gender, socio-economic class and literacy. Stratified Random Samplin was adopted.

4.3.4 Phase IV

In this Phase, the data and information collected were tabulated and anal arithmetic calculations were used. Proportions were calculated for all the v parameters. Bar diagrams and pie charts were used for presentation. Test of s used to find out the statistical significance of the findings. Methodox Systems designing the format as well as for analysis of the data. Presentation work was c special team of experts and RR Printers, Chennai.

5. Base Line Survey

Base Line Survey (BLS) is very essential to know the demographic profile of the study area. A format has been designed in consultation with Gandhigram Institute of Rural Health and Family Welfare Trust, Ambathurai, Dindigul and National Institute of Health and Family Welfare, New Delhi. NFHS II survey format tools are used as guidelines for this survey. Methodox Systems, Mumbai is hired for designing the format and analysis of the data.

The format designed was field tested by trained personnel and corrections were duly made. The format used to carry out the Base Line Survey is enclosed in the Annexure III

5.1 Training:

The Health and Epidemiological Study in Thoothukudi District around 5 Km radius of SIPCOT Industries was carried out in 81 villages identified for the survey (Annexure I). Experienced and qualified public health personnel were hired to conduct the survey for the work. They were given adequate training to carry out the study. In the First phase, the training was imparted on how to conduct the Base Line Survey. In the Second phase, they were given the training to identify the health problems of the people in the selected villages. In the third phase, selected health workers were given training on how to collect details on the environmental survey and general informations of the study villages.

District level officials and Doctors were given advocacy and sensitization at Government Thoothukudi Medical College. Dr. P. Saraswathi, Dean (Retd.), Thoothukudi Medical College chaired the session. Dr. A. Liaquat Ali, Deputy Director of Health Services (Retd.), Thoothukudi and Dr. Selvakumari, Deputy Director of Health Services, Kovilpatti were also present. Medical Officers from Mappilaiyurani, Puliyampathur, Pudukottai and Sivakalai Primary Health Centers and officials from the office of the Deputy Director of Health Services, Thoothukudi and Kovilpatti were participated. Akkam Trust, an NGO from Madurai was involved in planning and management of the survey.

Photo. 5.1
Dr. S. Elango, Principal Investigator briefing the Training Session

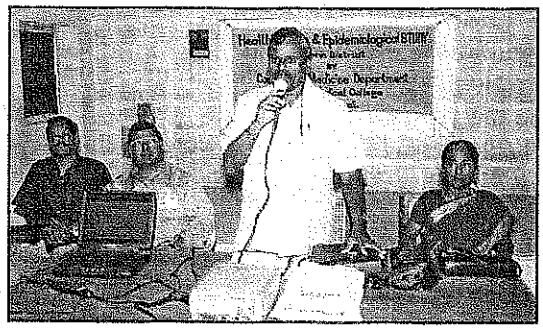
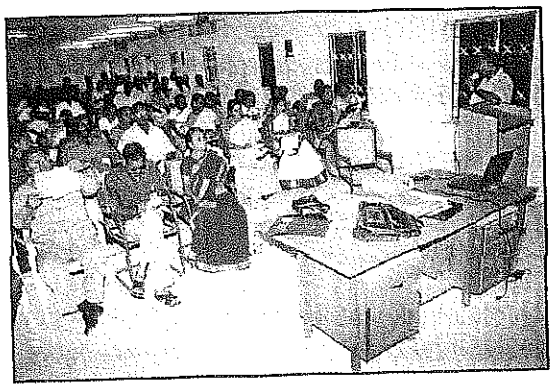


Photo. 5.2
Dr.Liaquat Ali, briefing the participants

Photo. 5.3 Participants in the Training



Block level training was organized at Thoothukudi. In this training Sector Health Nurses, Block Health Supervisors, Community Health Nurses, Health Inspectors and Statistical Assistants have attended the training. The prescribed format was used for the hands on training in the field and corrections were made in the field itself. A survey kit was supplied to all the participants involved in the survey. Adequate substitutes had also been trained to fill up the gap in case of emergencies.

Health Inspectors were given special training on environmental health to collect information from the villages. They were also trained to take water samples from the drinking water sources and to send the same for analysis to the Chief Water Analysis Laboratory, King Institute of Preventive Medicine, Guindy, Chennai.

Medical Officers and other Para medical staff engaged for the study from Primary Health Centres, and Government Medical Colleges in Thoothukudi and Tirunelveli were trained for organizing the medical camps, investigation, diagnosis, treatment and referral of the cases. They were also given training on registers to be maintained and reports to be furnished etc. The list of participants for the training is enclosed in Annexure II.

5.2 Seminars & Workshops:

Five seminars and three workshops have been organized for the survey. One Seminar was organized for the specialists who were engaged for the management of referred cases. Another seminar was organized at GIRH, Gandhigram for designing the format. Two seminars were conducted at the Directorate to finalize the programme. Two workshops have been organized for the Medical students of Tirunelveli Medical College who were engaged for the survey questionnaire. Twenty batches were given training for the survey against the estimated batch of ten.

5.3 Visits of the Project Officer:

The Project Officer visited the following institutions to get references and valid documents to be incorporated in the survey:

1. National Institute of Health and Family Welfare, New Delhi.
2. Indian Institute of Technology, Chennai.
3. Gandhigram Institute of Rural Health and Family Welfare Trust, Gandhigram
4. National Institute of Epidemiology, Chennai
5. JIPMER, Pondichery
6. National Institute of Nutrition, Hyderabad
7. Indian Institute of Science , Bangalore

Information was also collected from the National Institute of Occupational Health, Ahmedabad.

5.4 Experts and Specialist consulted for the Project:

1. Dr. S.K. Ray, Public Health Specialist, All India Institute of Hygiene and Public Health, Kolkata.
2. Dr. A. Ramalingeswara Rao, Retired Director of Public Health and Preventive Medicine, Chennai.
3. Dr. Munavarkhan, Retired Director of Public Health (Training).
4. Dr. Syad Piaz Peeran, Retired Additional Director of Public Health.
5. Mr. Gunasekaran, Chief Water Analyst, (Retd.) King Institute of Preventive Medicine, Chennai.

5.5 Selection of the Villages

A total of 81 villages were identified around 5 KM radius of SIPCOT industries, Thoothukudi District for the study. The name of the block and the villages are enclosed in Annexure I

5.6 Coverage:

During the survey, we had to cover 95 villages instead of 81 villages (117.2%). The number of households also increased from 14348 to 20181 (140.6%). The population surveyed was 80725 instead of 60527 (133.3%). Table 5.0 gives the coverage of villages and population

Table: 5.0 Coverage of Villages, Households and Population

Villages			HOUSEHOLDS			POPULATION		
No. of Villages Proposed	Actual Nos. Covered	% Covered	No. of House holds proposed	Actual Nos. Covered	% Covered	No. of Targeted Popula-tions	Actual Nos. Covered	% of Coverage
81	95	117.2%	14348	20181	140.6%	60527	80725	133.3%

5.7 Demographic Profile:

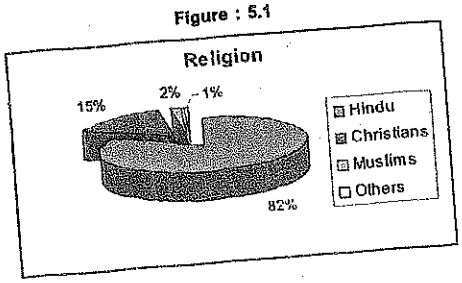
In the survey it reveals that the majority of the population belongs to Hindu religion and second religion is Christianity (Table & Fig.5.1). The sex ratio is almost equal (Table & Fig.5.2). But there is a difference in the proportion of the age wise sex population (Table & Fig.5.3). 52.2% belongs to Most Backward class and 29.5 % Scheduled Caste Communities (Table & Fig.5.4)

1. Religion

Table : 5.1

Religion	%
Hindu	82.9%
Christian	14.9%
Muslim	1.6%
Others	0.6%

Figure : 5.1

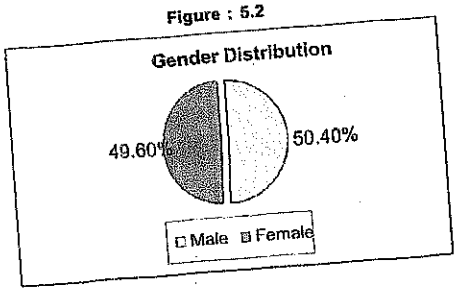


2. Gender

Table : 5.2

Sex	%
Male	50.4%
Female	49.6%

Figure : 5.2

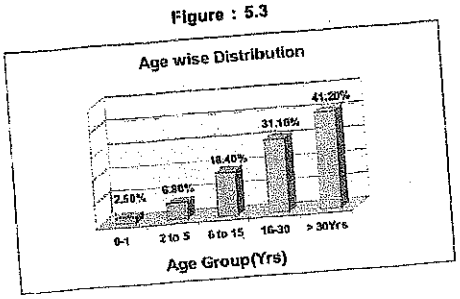


3. Age wise Population

Table : 5.3

Age Group	%
0-1 Yr	2.5%
2-5 Yrs	6.8%
6-15 Yrs	18.4%
16-30 Yrs	31.1%
>30 Yrs	41.2%

Figure : 5.3

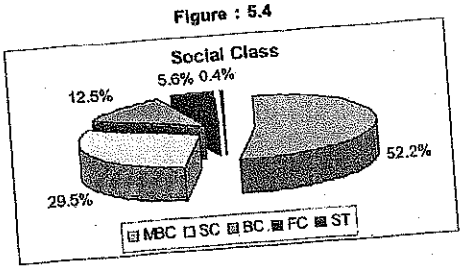


4. Social Class

Table : 5.4

Community	%
Forward	5.6%
BC	12.5%
MBC	52.0%
SC	29.5%
ST	0.4%

Figure : 5.4

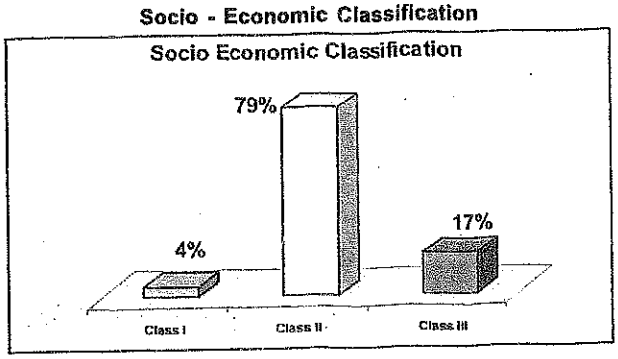


5.8 Socio-Economic Status:

The Socio Economic status of the study population is high when it is compared with state as a whole as shown in the figure below. The literacy rate is 80 % when compared to the state average of Tamil Nadu of 64.4 % (Table & Fig.5.6).

Fig : 5.30

Socio - Economic Classification

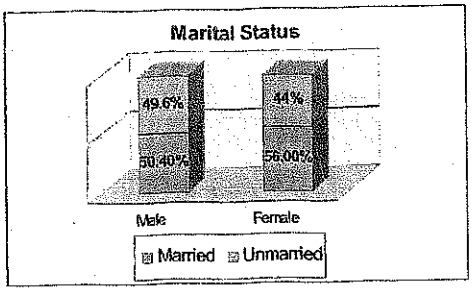


5. Marital Status

Table : 5.5

Sex	Married	Unmarried
Male	50.4%	49.6%
Female	56%	44%

Figure : 5.5

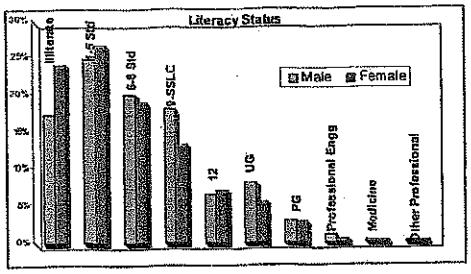


6. Educational Status

Table : 5.6

Education	Male	Female
Illiterate	17.45	24.15
1-5 Std	24.9%	26.75%
6-8 Std	20.1%	19.0%
9-SSLC	18.1%	13.4%
+2	6.6%	7.2%
UG	8.2%	5.6%
PG	3.1%	2.9%
Professional Engg	1.07%	0.5%
Medicine	0.32%	0.30%
Other Professional	0.16%	0.20%

Figure : 5.6



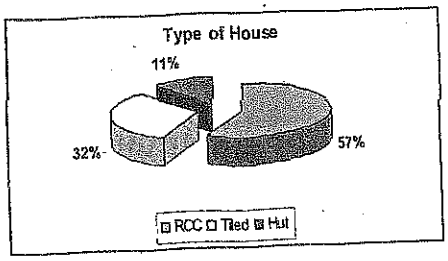
Majority of the people are having their own houses which are pucca houses like RCC and tiled houses (Table & Fig.5.7). More than 90 % of the people having electricity connection which is very high when compared to the National and State average (Table & Fig.5.9).

7. Type of House

Table : 5.7

Type of House	%
RCC	56.6%
Tiled	32.4%
Hut	11.0%

Figure : 5.7

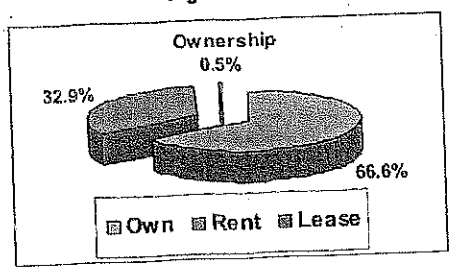


8. Ownership

Table : 5.8

Ownership	%
Own	66.6%
Rent	32.9%
Lease	0.5%

Figure : 5.8

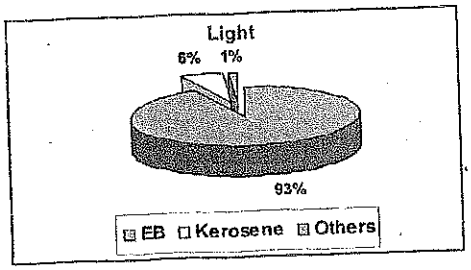


9. Light

Table : 5.9

Light	%
EB	93%
Kerosene	5.8%
Others	1.2%

Figure : 5.9



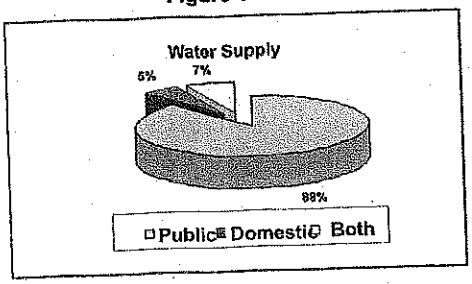
93 % of the population have protected water supply (Table & Fig.5.10 & 5.11). It is very significant to note that the toilets in the houses are very less even though they have their own houses. Majority of them use open air for defecation. (Table & Fig.5.14)

10. Water Supply (Utility)

Table : 5.10

Water Supply	%
Public	88.1%
Domestic	5.1%
Both	6.8%

Figure : 5.10

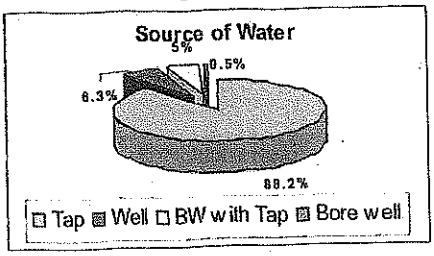


11. Source of Water Supply

Tabl : 5.11

Source of Water Supply	%
Tap	88.2%
Well	6.3%
Bore well with tap	5%
Bore well	0.5%

Figure : 5.11

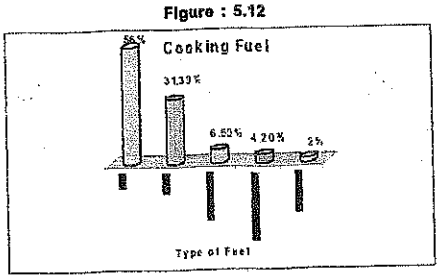


12. Cooking Fuel

Table : 5.12

Cooking Fuel	%
Fire Wood	56%
LPG	31.3%
Kerosene	6.5%
Kerosene & Fire wood	4.2%
LPG & Fire wood	2.0%

Figure : 5.12

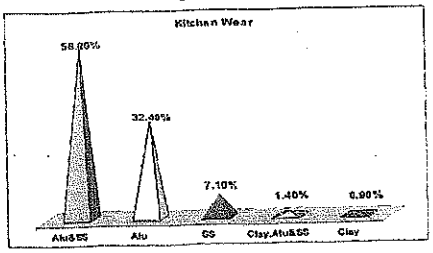


13. Kitchen Ware

Table : 5.13

Kitchen Ware	%
Aluminium & Stainless Steel	58.2%
Aluminium	32.4%
Stainless Steel	7.1%
Clay, Aluminium & SS	1.4%
Clay	0.9%

Figure : 5.13

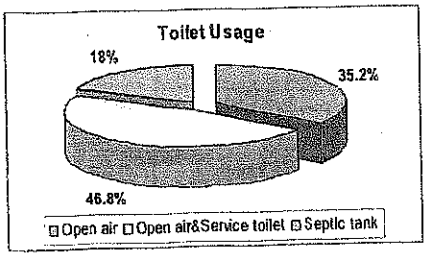


14. Toilet Usage

Table : 5.14

Toilet Usage	%
Open Air	35.2%
Open Air & Service Toilet	46.8%
Septic Tank	18%

Figure : 5.14



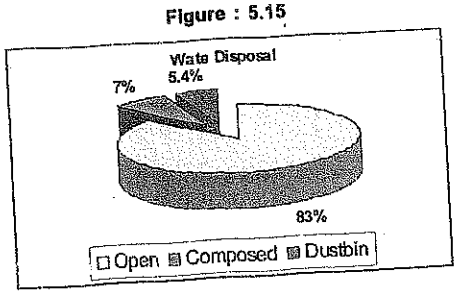
The solid waste disposal is also indiscriminate and they use the open air for disposal. (Table & Fig. 5.15). Only 6.7 % have the drainage system but 49 % of the people let out the sewage water into the streets. (Table & Fig. 5.16).

15. Solid Waste Management

Table : 5.15

Waste Disposal	%
Open	83%
Composed	7%
Dustbin	5.4%
Others	4.6%

Figure : 5.15

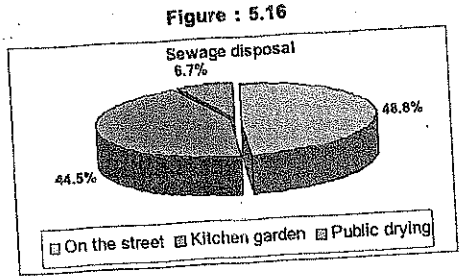


16. Sewage

Table : 5.16

Sewage Disposal	%
Let out on the street	48.8%
Kitchen Garden	44.5%
Public drying	6.7%

Figure : 5.16

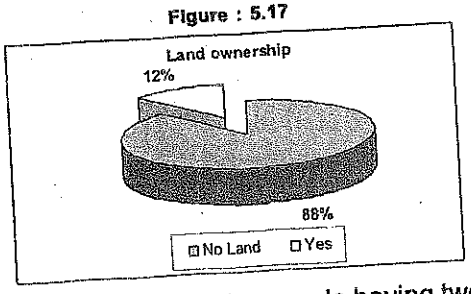


17. Agricultural Land Ownership

Table 5.17

Land Ownership	%
No Land	88.3%
Yes	11.7%

Figure : 5.17



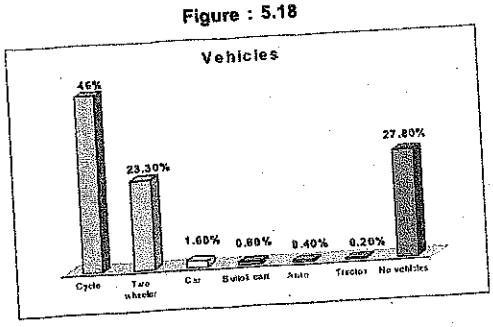
Almost 72.3 % of people have some vehicle or other and the people having two wheelers in rural areas are significantly high. (Table & Fig. 5.18).

18. Vehicles

Table : 5.18

Vehicles	%
Cycle	46.1%
Two Wheelers	23.3%
Car	1.6%
Bullock Cart	0.6%
Auto	0.4%
Tractor	0.2%
No Vehicles	27.8%

Figure : 5.18



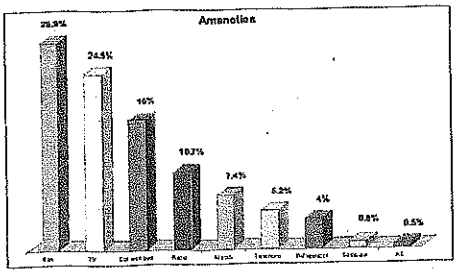
Most of the houses have additional amenities like Television, AC, Phone, Refrigerators etc. (Table & Fig. 5.19)

19. Amenities

Table : 5.19

Amenities	%
Fan	28.9%
TV	24.5%
Cot with bed	18%
Radio	10.7%
Mobile	7.4%
Telephone	5.2%
Refrigerator	4.0%
Computer	0.8%
AC	0.5%

Figure : 5.19

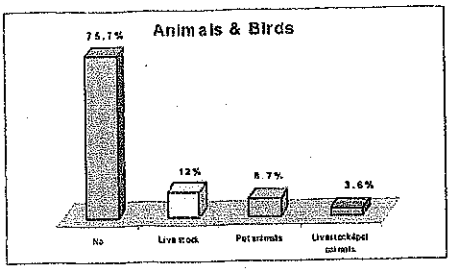


20. Rearing Animals and Birds

Table : 5.20

Animals & Birs	%
No	75.7%
Live stock	12.0%
Pet Animals	8.7%
Live stock & pet animals	3.6%

Figure : 5.20

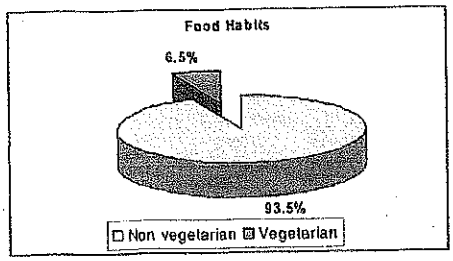


21. Food Habit

Table : 5.21

Food Habit	%
Non Vegetarian	93.5%
Vegetarian	6.5%

Figure : 5.21



When the social status, literacy, annual income and other amenities are computed the people in the survey area falls in the following categories of socio-economic classification:

CLASS - I - 4.0 %

CLASS II - 79.0 %

CLASS III - 17.0 %,

So, majority of them were under class II categories.

5.9 Deliveries and Utilisation of Hospital Facilities:

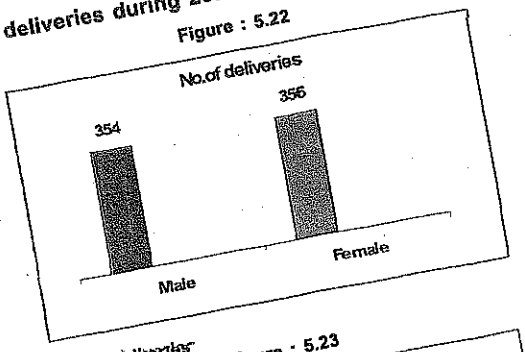
There were 710 births in the year 2006 of which 354 are males and 356 are female babies (Table & Fig.5.22). 64.9% use the services of Government hospitals and 31.6% use Private hospitals for deliveries (Table & Fig.5.23). 19.4% babies are less than 2 kg of birt weight, which is significantly lower when compared with the state average which is 30% (Table & Fig.5.25)

22. Total deliveries during 2006

Table : 5.22

Deliveries	%
Male	354
Female	356
Total	710

Figure : 5.22

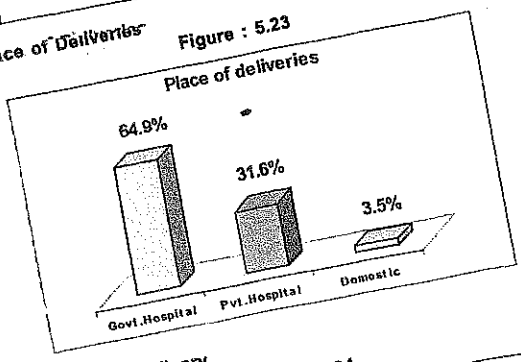


23. Place of Deliveries

Table : 5.23

Places	%
Govt. Hospitals	64.9%
Private Hospitals	31.6%
Domestic Deliveries	3.5%

Figure : 5.23

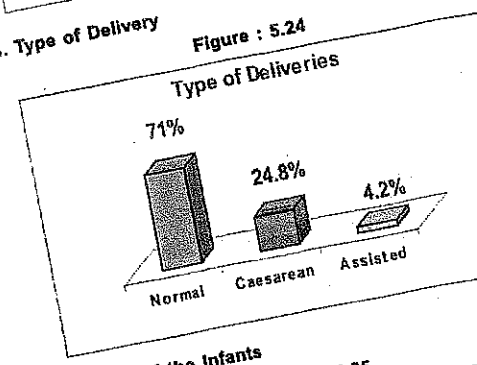


24. Type of Delivery

Table : 5.24

Type of Delivery	%
Normal	71%
Caesarean	24.8%
Assisted	4.2%

Figure : 5.24

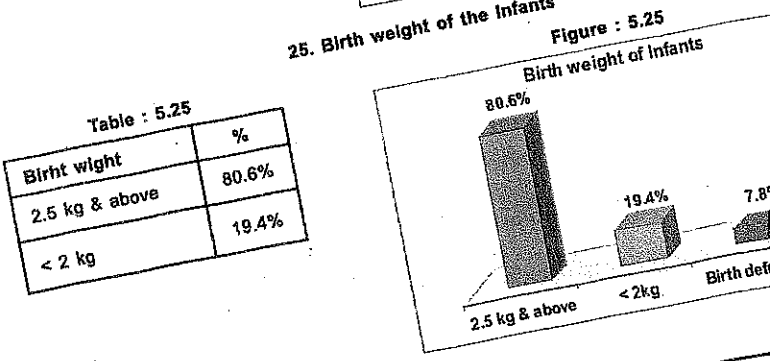


25. Birth weight of the Infants

Table : 5.25

Birht wight	%
2.5 kg & above	80.6%
< 2 kg	19.4%

Figure : 5.25



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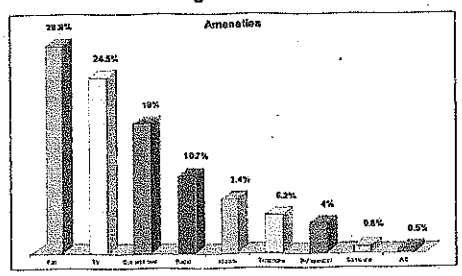

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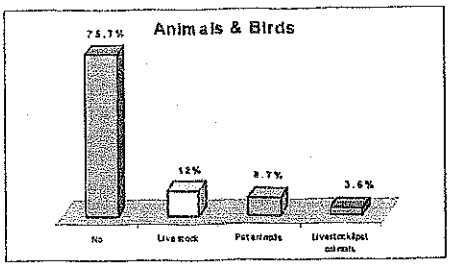

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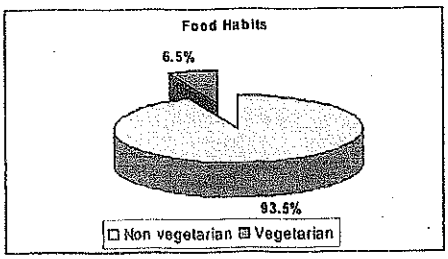

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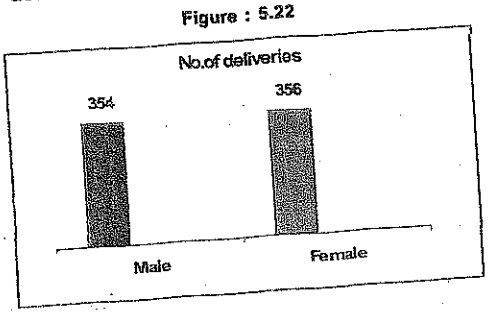

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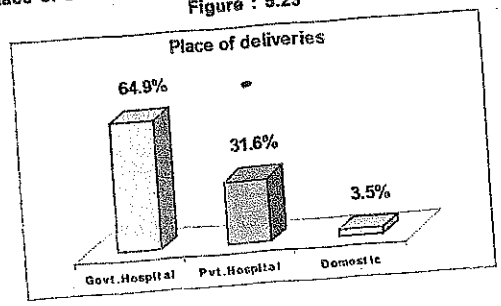

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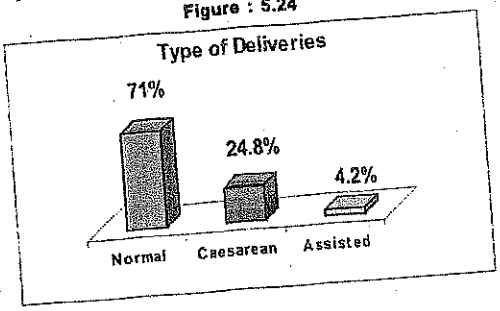

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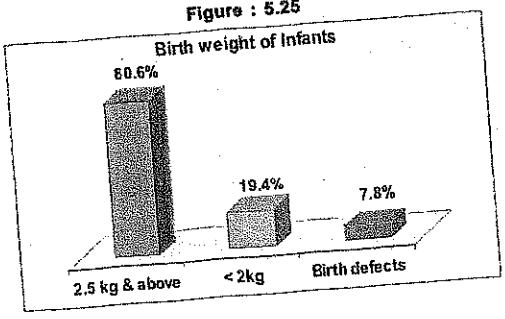


5.10 Diseases and common causes of Mortalities:

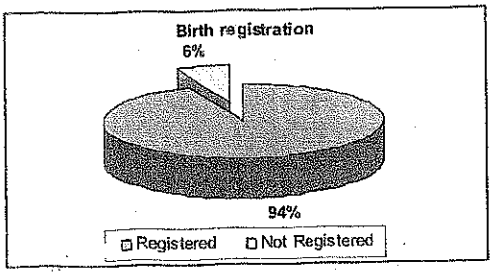
46% people were affordable to go to private clinics for getting treatment. Only 41% goes to the Government hospital (Table & Fig. 5.29). Diseases and chronic illness is the major cause of deaths. Old age and natural causes are the second major cause of deaths in the area. 10% of the victims die due to accident and suicide and murder seems to be very high in the area when compared to the National and State average. (Table & Fig. 5.27).

26. Birth Registration

Table : 5.26

Birth Registration	%
Registered	93.8%
Not Registered	6.2%

Figure : 5.26

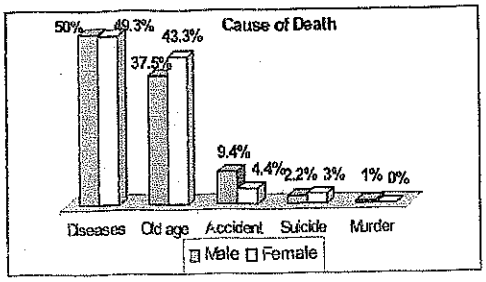


27. Cause of Death

Table : 5.27

Category	Male	Female
Disease	50%	49.3%
Old age natural cause	37.4%	43.3%
Accident	9.4%	4.4%
Suicide	2.2%	3.0%
Murder	1.0%	-

Figure : 5.27

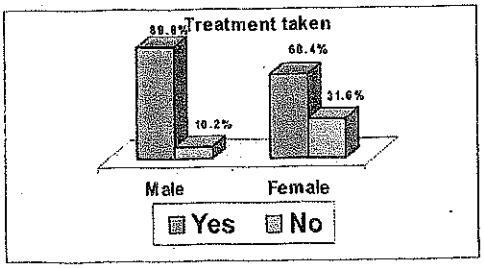


28. Treatment taken for disease

Table : 5.28

Treatment	Male	Female
Yes	89.8%	68.4%
No	10.2%	31.6%

Figure : 5.28

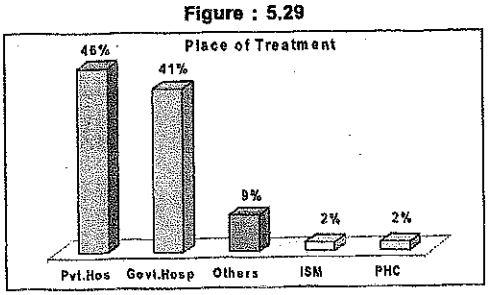


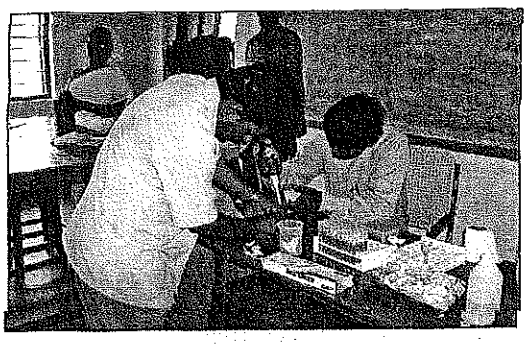
29. Place of Treatment

Table : 5.29

Place	%
Pvt. Hospital	46%
Govt. Hospital	41%
Others	9%
ISM	2%
PHC	2%

Figure : 5.29





6. Nutritional Health Status

Health status of the people includes the Nutritional status of the individuals. Hence HES survey has also covered the nutritional status assessment of the people as part of the study.

The investigations included collection of data from 798 HHs which was covered in 95 villages. About 3,114 individuals of different age groups and both gender were covered for anthropometry, clinical examination and nutritional deficiencies. 24-hours recall method of diet survey was used to assess the food and nutrient intakes of households and individuals.

6.1 Study design

It was a cross-sectional study, carried out by adopting multistage stratified random sampling procedure.

6.2 Sample Frame

Two stage stratified random sampling was adopted. Based on the social class under Kuppusamy's classification, in each class the required proportion of sample was calculated. By random sampling technique, the sample was drawn from the 95 study villages.

6.3 Selection of HHs:

In each geographical area, the HHs was enumerated starting from northeast corner and by continuing in a serpentine order. In the case of a large village, where the number of HHs in a geographical area was more than 100, such area was subdivided into 2 or more sub-areas, based on natural groups of HHs and from them one group was selected randomly for enumeration. The first HH (with random start) for survey was selected randomly using random number tables: Starting from this household, four consecutive HHs were covered for the survey. In case, the selected house was found locked, next adjacent HH was covered. Similar procedure was adopted for covering HHs in all the remaining geographical areas. Thus, in each village, a total of 8-10 HHs were covered.

6.4 Nutritional Status

All the available individuals from the 8-10 selected HHs in each villages were covered for assessment of Nutritional status in terms of anthropometry and clinical examination.

6.5 Diet survey

Twenty-four hours recall method of diet survey was carried out in a sub sample of 5 HHs (every alternate household covered for anthropometry) to assess the food and nutrient intake at the household as well as individual level.

6.6 Food and Nutrient intakes of Households / Individuals

The average daily intakes of different foods by individuals were calculated according to different age/sex, physiological status (pregnant women of ≥ 12 weeks gestation and lactating women of ≤ 12 months duration) and physical activity groups and were compared with the recommended least cost balanced diets provided in recommended dietary intakes

for Indians. The average nutrient intakes were calculated by using food composition tables in Nutritive value of Indian Foods. The median as well as mean ± SD intakes of various nutrients were computed and compared with recommended dietary Allowances of Indians (1991) suggested by the ICMR Expert Committee. In addition, the average intake of various foods and nutrients (per CU/day) at the household level was also computed.

The households were categorized according to the protein/Calorie adequacy status by considering average consumption of protein/calorie per Consumption Unit (the requirements of reference man was considered as one Unit) per day and by adopting similar procedure described above. However, the cut-off level used to define the adequacy status of a household was "Requirement-2 SE", since the intakes at HH level are mean values, unlike in the case of individuals. It may also be mentioned here that the SE differ between HHs, since the total CUs for each of the HHs are variable.

6.7 Anthropometry

a. Anthropometry

Measurements such as height, weight, mid upper arm circumference and fat fold thickness at triceps were taken on all the individuals in the selected HHs by adopting standard procedures. In addition, waist and hip circumferences were also measured on adults of ≥ 20 years of age (excluding pregnant women). All the measurements were taken by using standard equipment and procedures.

Mean height, weight mid-upper arm circumference and fat fold thickness at triceps were calculated according to age group and gender.

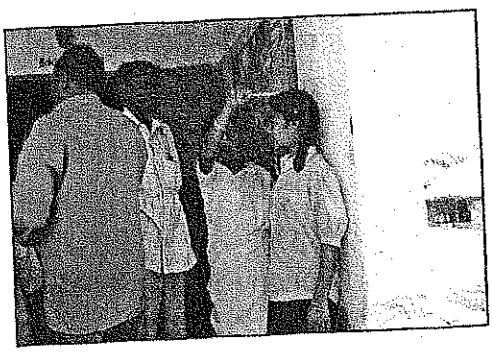
b. Waist circumference

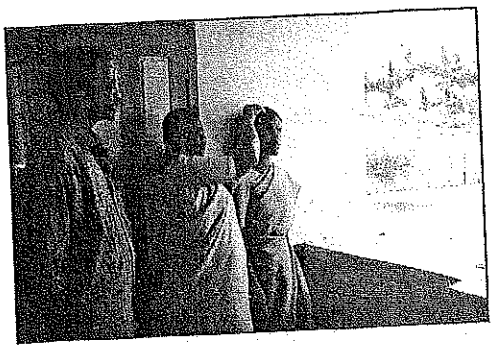
Waist circumference was measured with a fiber reinforced plastic tape at point mid way between the lowest margin of the ribs and the iliac crest.

c. Hip Circumference

Hip circumference was measured with the tape at the point of maximum protuberance of buttocks.

Photo 6.1 Anthropometry Measurements





6.8 Estimation of Haemoglobin Procedure

20 µl of finger prick blood sample was collected using fixed volume Finn pipettes with disposable tip, by standard procedures and transferred into a test tube containing 5 ml of Drabkin's reagent. The haemoglobin was estimated using a photoelectric digital colorimeter by cyanmethaemoglobin method. Commercial Haemoglobin kits (Dr. Reddy's Laboratories or Glaxo Laboratories or Zydus Pathline) were used for the purpose. (Photo 6.2 & 6.3)

Photo. 6.2 Collection of Blood for Hemoglobin analysis

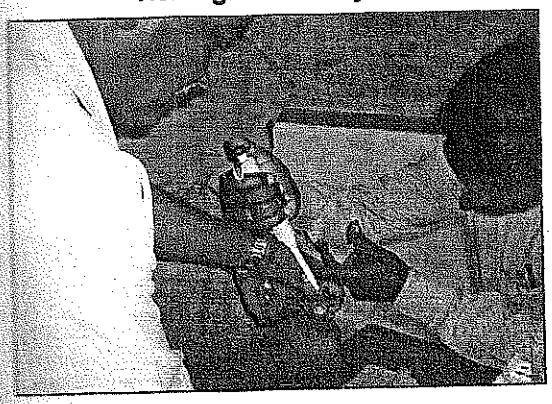
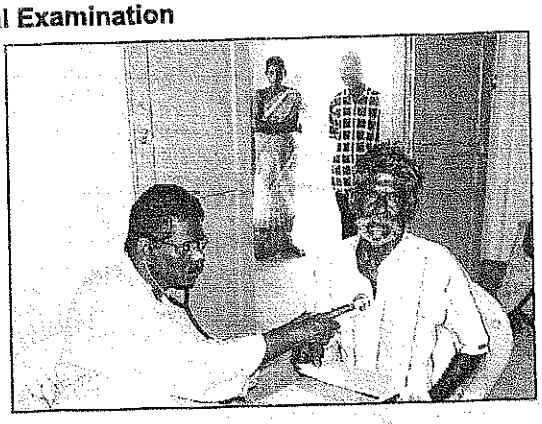


Photo.6.3 Estimation of Hemoglobin by Cyanmethaemoglobin method

6.9 Clinical Examination

All the individuals covered for anthropometry were examined for presence of clinical signs of nutritional deficiencies. (Photo 6.4) In addition, history of prevalence of symptoms such as night blindness was elicited from the subjects (from mothers of young children)

Photo.6.4 Clinical Examination



6.10 Assessment of Nutritional Status

a) Pre-school Children

The < 5-year children were categorized according to their nutritional status by Gomez Classification.

Table 6.1 Gomez Classification

Weight for age (% of NCHS Standard)	Nutritional Grade
≥90	Normal
75-89.99	Grade I (Mild under nutrition)
60-74.99	Grade II(Moderate under nutrition)
< 60	Grade III (Severe under nutrition)

IAP Classification

The 6-59 months children were distributed according to IAP classification as below using Harvard Standards to help comparison with ICDS data.

Table 6.2 IAP Classification

Weight for age (% of Harvard Standard)	Nutritional Grade
≥80	Normal
70-79.99	Grade I Under nutrition
60-69.99	Grade II Under nutrition
50-59.99	Grade III Under nutrition
< 50	Grade IV Under nutrition

b) School age Children and Adolescents

Children of 6-9, 10-13 and 14-17 year age groups were distributed according to weight for age, Height for age and Weight for Height by SD classification using NCHS standards. In addition, 10-13 and 14-17 year age group of children were distributed according to nutritional status based on Body Mass Index (BMI) by using the NHANES age/gender specific BMI centile values, as mentioned below

Table 6.3 BMI and Grading of Nutritional Status

BMI Age centiles	Nutritional Grade
< 5^{th} centile	Under Nutrition
≥5^{th} - ≤ 85^{th} centile	Normal
≥ 85^{th} - ≤ 95^{th} centile	Overweight
≥95^{th} centile	Obesity

Table 6.4 Degree of Anemia

Gender	Normal	Degree of Anaemia (g/dL)		
		Mild	Moderate	Severe
Men	≥13	10 - 13	7 - 10	≤ 7
Women	≥ 12	10 - 12	7 - 10	≤ 7

6.11 Quality Control

To ensure quality control, every 10th sample was verified by the supervisors to ensure internal consistency. All biochemical and microbiological samples were supervised by the technical supervisors. Duplicate sample of every third sample was sent to 2nd laboratory for confirmation of the results.

In addition, anthropometric measurements, assessment of haemoglobin, and physical examinations were repeated in a sub-sample of individuals in the field during periodical visits by the specialists as a quality control measure.

6.12 Results

6.12.1. Household Food and Nutrient intakes

The average household daily intakes of food and nutrients among individuals of different age and sex are given in Table 6.5 and 6.6. In general, cereals formed the bulk of the dietaries of the rural population surveyed, while millets were consumed in small quantities. The average intake of cereals and millets was about 386g/CU/day, which is about 84% of RDI, pulses & legumes was 37 g, which is about 93% of RDI. The average consumption of green leafy vegetables was 10g which is below the suggested levels of 40g whereas consumption of other vegetables was relatively better (46g). The intake of roots and tubers was lower (41g), milk and milk products was about 102 g/CU/day, the consumption was less than the recommended levels of 150 g. The average consumption of fats and oils (12g/CU/day) was less than the suggested levels of 20g, Sugar & Jaggery was about 17g/CU/day), which was less than the suggested levels of 30g.

The median intake of protein was low 41g and total fat was 15.2 g/CU/day. The overall median intake of energy was 1740 Kcals, which was about 73 % of recommended levels. The median daily intake of calcium was 322 mg which was below the RDA (400 mg) level. The median intake of iron (8.8mg) (RDA 28mg) and Vitamin A 132, µg/CU/day (RDA 600 mg). Consumption of thiamin & niacin fulfilled the RDA. Intake of riboflavin 0.6 mg/CU/day was less than the recommended level of 1.4 mg. The median intake of Vitamin C & Free folic acid is 31mg & 55.5 µg/CU/day.

Table 6.4 Degree of Anemia

Gender	Normal	Degree of Anaemia (g/dL)		
		Mild	Moderate	Severe
Men	≥13	10 - 13	7 - 10	≤ 7
Women	≥ 12	10 - 12	7 - 10	≤ 7

6.11 Quality Control

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Table 6.5 Average Household Consumption of Food Stuff (g/CU/day)

No.of HH's		Cereals	Millets	Cereals & Millets	Pulses & Millets	Green Leafy Vege-tables	Other Vege-tables	Roots & Tubers	Fruits	Fish	Other Flesh Foods	Milk Flesh foods	Fats & Oils	Sugar & Jagger
798	Mean	383	3	386	37	10	46	41	42	9	2	102	12	17
	SD	87	23	110	29	27	49	41	32	34	12	111	9	13

Table 6.6 Average Household Consumption of Nutrients (CU/day)

No.of HH's		Protein (g)	Total Fat (g)	Energy (Keal)	Calcium (mg)	Iron (mg)	Vitamin A (mic.g)	Thiamin (mg)	Riboflavin (mg)	Niacin (mg)	Vit-C (mg)	Free Folic acid (mic.g)
798	Median	41.3	15.2	1740	322	8.8	132	1.2	0.6	16.1	31	55.5
	SD Mean	43.3	17.6	1772	393	10.2	199	1.2	0.6	16.2	45	58.2
	SD	12.3	11.3	367	284	5.6	253	0.3	0.2	4.2	43	17.9

6.12.2. Food and Nutrient intake of individuals

Food intake of individuals

The average daily intakes of food and nutrients among individuals of different age and sex groups are given below. (Table No.6.7 to 6.19)

1-9 year children

The average daily intake of cereals and millets among 1-3 year children was (115g) about 66% of RDI. The mean intake of pulses and legumes (13g) was about one third of the RDI (35g). The consumption of green leafy vegetables was 5g and it was negligible. The intake of other protective foods were lesser than the RDI.

The mean intake of cereals and millets among 4-6 year children was (191g) about 70% of the RDI and that of pulses was 22g. The Consumption of milk and milk products was grossly inadequate. The consumption of green leafy vegetables was negligible (6g).

The mean intake of cereals and millets among 7-9 years was 234g, while that of the pulses and legumes was 27g. the levels of consumption of other foods such as GLV (7g), milk (77ml), fats and oils (8g) and sugar and jaggery (10g).

10-17 year boys

The mean intake of cereals & millets and pulses among 10-12 years were 268 g and 32 g as against of RDI 420 g and 45g respectively. The intake of all other foods was lower than the RDI, except roots and tubers. The mean intake of cereals and millets among 13-15 years was 331g. The average consumption of cereals millets among 16-17 years was 390 g and pulses were 33g.

10-17 year girls:

The intake of cereals and millets among 10-12 year girls was less (274 g) and RDA was 380g. The intake of pulses, GLV, milk and sugar were grossly inadequate and was less than half the suggested levels. The mean intake of cereals and millets among 13-15 year girls was 317g while that of pulses was 32g. The average intake of cereals and millets among 16-17 year girls was 357g, while that of pulses was 34g.

Adult Male

The average intake of cereals and millets among adult men engaged in sedentary work 423g was about 92% of the RDI (460g). Except pulses, root and tubers, the intake of all other foods was lower than the suggested levels. In case of adult males engaged in moderate activity, the average intake of cereals and millets 505g was less than the RDI of 520g.The intake of all other foods was lower than the suggested levels.

Adult Female

The average consumption of cereals and millets among NPNL women engaged in sedentary work 353g was about 86% of the RDI (410g). Baring other vegetables and milk products, the average intake of all the other foods was lower than the suggested levels. The extent of deficit was highest with respect to green leafy vegetables (90%). Among those engaged in moderate activity, the average intake of cereals & millets (400g) were 91% of the RDI (440g). Baring other vegetables, the intakes of all the other foods was lower than the suggested levels.

The intake of cereals & millets among pregnant Women 373 g, was comparable to the RDI of NPNL women (410g).Obviously, no additional amounts are consumed to meet the increased requirements due to pregnancy. The intake of all other foods was much below the levels suggested for NPNL women. The average consumption of cereals and millets among lactating women (427g) was higher than the intake among NPNL women (400g) and that of pregnant women. (373g).

Table 6.7 Intake of Food (g/Day) in 1-3 yrs of Children

Food Stuffs	Male g/CU/day	Female g/CU/day	Recommended level in g/CU/day
Cereals	114.0		175
Millets	1.0		-
Pulses & Legumes	13.0		35
Leafy Vegetables	5.0		40
Other Vegetables	19.0		20
Roots & Tubers	14.0		10
Nuts & Oil Seeds	2.0		-
Condiments & Spices	5.0		-
Fruits	14.0		-
Fish	2.0		-
Other Flesh Foods	3.0		-
Milk & Milk Products	152.0		300
Fats & Oils	4.0		25
Sugar & Jaggery	12.0		30

Table 6.8 Intake of Food (g/Day) in 4-6 yrs Children

Food Stuffs	Male & Female g/CU/day	Recommended level in g/CU/day
Cereals	190.0	270
Millets	1.0	-
Pulses & Legumes	22.0	35
Leafy Vegetables	6.0	50
Other Vegetables	30.0	30
Roots & Tubers	22.0	20
Nuts & Oil Seeds	3.0	-
Condiments & Spices	10.0	-
Fruits	19.0	-
Fish	4.0	-
Other Flesh Foods	3.0	-
Milk & Milk Products	79.0	250
Fats & Oils	6.0	25
Sugar & Jaggery	10.0	40

Table 6.9 Intake of Food (g/Day) in 7-9 yrs Children

Food Stuffs	Male & Female g/CU/day	Recommended level in g/CU/day
Cereals	234.0	270
Millets	<1	-
Pulses & Legumes	27.0	35
Leafy Vegetables	7.0	50
Other Vegetables	32.0	30
Roots & Tubers	23.0	20
Nuts & Oil Seeds	3.0	-
Condiments & Spices	14.0	-
Fruits	23.0	-
Fish	5.0	-
Other Flesh Foods	2.0	-
Milk & Milk Products	77.0	250
Fats & Oils	8.0	25
Sugar & Jaggery	10.0	40

Table : 6.10 Intake of Food (g/Day) in 10-12 yrs Children

Food Stuffs	Male g/CU/day	Recommended level in g/CU/day	Female g/CU/day	Recommended level in g/CU/day
Cereals	268	420	270	380
Millets	<1	-	4	-
Pulses & Legumes	32	45	29	45
Leafy Vegetables	4	50	8	50
Other Vegetables	39	50	3	50
Roots & Tubers	29	30	22	30
Nuts & Oil Seeds	3	-	2	-
Condiments & Spices	12	-	16	-
Fruits	32	-	26	-
Fish	7	-	5	-
Other Flesh Foods	3	-	<1	-
Milk & Milk Products	93	250	47	250
Fats & Oils	9	22	8	22
Sugar & Jaggery	11	45	7	45

Table : 6.11 Intake of Food (g/Day) in 13-15 yrs Children

Food Stuffs	13-15 Yrs		16-17 Yrs	
	Male	Female	Male	Female
Cereals	330	310	386	353
Millets	1	7	4	4
Pulses & Legumes	36	32	33	34
Leafy Vegetables	7	6	12	5
Other Vegetables	33	35	45	32
Roots & Tubers	39	32	41	32
Nuts & Oil Seeds	4	5	3	4
Condiments & Spices	17	16	17	15
Fruits	34	32	45	32
Fish	11	4	3	15
Other Flesh Foods	1	2	4	<1
Milk & Milk Products	55	65	63	76
Fats & Oils	10	9	9	10
Sugar & Jaggery	9	9	8	8

Table 6.12 Intake of Food (g/Day) in Adults

Food Stuffs	Male g/CU/day	Recommended level in g/CU/day	Female g/CU/day	Recommended level in g/CU/day
Cereals	500	520	393	440
Millets	5	-	7	-
Pulses & Legumes	42	50	30	45
Leafy Vegetables	12	40	9	100
Other Vegetables	55	70	41	40
Roots & Tubers	48	60	39	50
Nuts & Oil Seeds	5	45	3	25
Condiments & Spices	19	-	15	-
Fruits	53	-	41	-
Fish	12	-	8	-
Other Flesh Foods	2	-	1	-
Milk & Milk Products	78	200	55	150
Fats & Oils	14	20	10	20
Sugar & Jaggery	10	35	9	20

6.12.3. Nutrient Intake of individuals

The average daily intakes of nutrients among individuals of different of age and sex groups are given below

1-9 year Children

In general, the median intakes of all the nutrients (1-3 years) were less than RDA. The median intake of energy was 691 Kcals as against RDA of 1240 Kcals and protein was 17g. The intakes of micronutrients such as vitamin A, Vitamin C, Calcium, Iron and riboflavin were found to be grossly in adequate. The median intakes of all the nutrients (4-6year) were below the RDA, the median intake of energy was 944 Kcals was less than RDA (1690 Kcals).The median intakes of all the (7-9year) nutrients were less than the RDA. The extent of deficit was relatively high with respect to intake of micronutrients.

10-12 year Boys and Girls:

To consumption levels of all the nutrients were less than the RDA. The intake of energy was very low (1259 Kcals). The diets were grossly deficient in micronutrient such as vitamin A, Iron and riboflavin. As observed in the case of boys, the median intake of all the nutrients was less than the RDA. The intake of energy was very low (1217 Kcals). The extent of deficit was very much higher in case of micronutrients such as vitamin A, riboflavin and iron.

13-15 year Boys and Girls:

In general, the median intake of all the nutrients was less than the RDA. The median intake of energy was less (1476 Kcals). In general, the median intake of all the nutrients was less than the RDA. The median intake of energy was less than 1465 Kcals.

16-17 year Boys and Girls:

In general, the median intakes of all the nutrients were less than the RDA. The intake of micronutrients such as Vitamin A, riboflavin and iron were grossly inadequate. The median intake of energy (593 Kcals) was lower than the RDA of 2060 Kcals. The intake of micronutrients such as iron & vitamin A were not even meeting the 50% of re commended levels.

Adult Men and Women:

Baring calcium, thiamine, and niacin, the median intakes of all the other nutrients among sedentary adult men were lower than RDA. The median intake of energy was 1995 Kcals as against RDA of 2425 Kcal. In case of adult males engaged in moderate work, the median intake of energy was (2214 Kcals) much below the RDA of 2875 Kcals. The intakes of Vitamin A and riboflavin were highly inadequate.

Among Adult females engaged in sedentary work, the median intakes of all the nutrients baring Thiamine, niacin & vitamin-C were below the recommended levels. The energy intake was 1629 Kcals. The median intake of protein was 39g. In case of those engaged in moderate

work, the median intakes of all the nutrients baring thiamine, niacin & vitamin-C were below the recommended levels. The energy intake was 1721 Kcals as against RDA of 2225 kcals. The median protein intake was low (38g), while it was comparable with RDA (50g). The intakes of iron, vitamin A, riboflavin and free folic acid were grossly deficient, as compared to RDA.

Among pregnant women, the median intake of energy was lower (1665 Kcals) than the RDA. The intake of micronutrients such as free folic acid, Vitamin A, iron and riboflavin was grossly inadequate. The median intakes of energy (1869 kcals) and protein (45g) among lactating women were much below the recommended levels of 2425 Kcals and 75g respectively. The intakes of micronutrients such as iron, calcium, vitamin A, riboflavin, free folic acid and vitamin C were much below the recommended levels.

6.12.4. Protein Calorie adequacy status:

1-3 year children

Only about 23.2% of 1-3 children were consuming adequate amount of both protein and energy. About 55.2% of the children were consuming adequate amounts of protein, but inadequate of calories. Thus, it was observed that the diets were predominantly deficient in calories than protein.

4-6 year children

Only 12.4% of the children were consuming adequate amounts of both protein and calories. About 73% of the children were consuming adequate amounts of protein, but inadequate of amounts of calories.

7-9 year children

Only 10% of the children were consuming adequate amount of both protein and calories. About 79% of the children were consuming adequate amount of protein but, inadequate amount of calories.

10-12 year boys and girls

About 9% of boys and 8% of girls were consuming adequate amount of both protein and calories, while 11% boys and 15% girls were consuming inadequate amount of both protein and calories. About 76% of boys and 68% of girls were consuming adequate amounts of protein, but inadequate amounts of calories.

13-15-year Boys and Girls

About 18% of boys and 24% of girls were consuming adequate amounts of both protein and calories. About 63 % of the boys and 70% girls were consuming adequate amounts of protein, but inadequate amounts of calories.

16-17 year Boys and Girls

About 28% of boys and 63 % of girls were consuming adequate amounts of protein and energy, while 53% of boys 29% of girls were consuming inadequate amount of both the nutrients.

Adult Men and Women

About 70% of adult men were consuming adequate amounts of both protein and calories, while about 11% were consuming inadequate amounts of both the nutrients. About 80% of adult NPNL women were consuming adequate amounts of protein and calories, while about 10% were consuming inadequate amounts of both the nutrients. Among the pregnant women, 57% were consuming adequate amounts of both protein and calories, while about 26% were consuming in adequate amounts of both the protein and calories. About 60% of lactating women were consuming adequate amounts of protein and calories while 23% were consuming inadequate amounts of both the nutrients.

Table: 6.13 Intake of Nutrients / Day in 1-3 yrs children

Nutrients	Male & Female / day	Recommended / day
Protein (g)	17.9	22
Total fat (g)	11.7	-
Energy (Kcal)	680	1240
Calcium (mg)	283	400
Iron (mg)	3.7	12
Vitamin A (mic.g)	144	400
Thiamin (mg)	0.4	0.6
Riboflavin (mg)	0.4	0.7
Niacin (mg)	5.1	8
Vit-C (mg)	18	30
Free folic acid(mic.g)	26.2	30

Table: 6.14 Intake of Nutrients / Day in 4-6 yrs children

Nutrients	Male & Female / day	Recommended / day
Protein (g)	23.8	3
Total fat (g)	10.7	-
Energy (Kcal)	945	1690
Calcium (mg)	246	400
Iron (mg)	5.3	18
Vitamin A (mic.g)	136	400
Thiamin (mg)	0.6	0.9
Riboflavin (mg)	0.4	1.0
Niacin (mg)	8.2	11
Vit-C (mg)	25	40
Free folic acid(mic.g)	33.3	40

Table: 6.15 Intake of Nutrients / Day in 7-9 yrs children

Nutrients	Male & Female / day	Recommended / day
Protein (g)	28.1	41
Total fat (g)	11.6	-
Energy (Kcal)	11.29	1950
Calcium (mg)	251	400
Iron (mg)	6.5	26
Vitamin A (mic.g)	132	600
Thiamin (mg)	0.7	1.0
Riboflavin (mg)	0.4	1.2
Niacin (mg)	10.1	13
Vit-C (mg)	28	40
Free folic acid(mic.g)	32.3	60

Table: 6.16 Intake of Nutrients / Day in 10-12 yrs children

Nutrients	Male day	Recommended / day	Female day	Recommended / d
Protein (g)	32.6	54	30.2	57
Total fat (g)	13.6	-	11.0	- -
Energy (Kcal)	1289	2190	1246	1970
Calcium (mg)	296	600	247	600
Iron (mg)	7.4	34	7.8	19
Vitamin A (mic.g)	159	600	116	600
Thiamin (mg)	0.9	1.1	0.8	1.0
Riboflavin (mg)	0.5	1.3	0.4	1.2
Niacin (mg)	11.6	15	11.5	13
Vit-C (mg)	30.0	40	27.0	40
Free folic acid(mic.g)	44.9	70	40.6	70

Table: 6.17 Intake of Nutrients / Day in 13-15 yrs children

Nutrients	Male day	Recommended / day	Female day	Recommende
Protein (g)	37.3	70	34.6	65
Total fat (g)	14.6	-	14.2	-
Energy (Kcal)	1524	2450	1449	2060
Calcium (mg)	312	600	263	600
Iron (mg)	8.9	41	8.4	28
Vitamin A (mic.g)	179	600	139	600
Thiamin (mg)	1.0	1.2	1.0	1.0
Riboflavin (mg)	0.5	1.5	0.4	1.2
Niacin (mg)	14.3	16	13.8	1.4
Vit-C (mg)	38	40	34.0	40
Free folic acid(mic.g)	48.6	100	47.6	100

Table: 6.18 Intake of Nutrients / Day in 16-17 yrs children

Nutrients	Male day	Recommended / day	Female day	Recommended / day
Protein (g)	40.5	78	40.3	63
Total fat (g)	14.0	-	14.6	-
Energy (Kcal)	171.3	2640	1604	2060
Calcium (mg)	370	500	347	500
Iron (mg)	10.6	50	9.3	30
Vitamin A (mic.g)	240	600	132	600
Thiamin (mg)	1.2	1.3	1.1	1.0
Riboflavin (mg)	0.6	1.6	0.5	1.2
Niacin (mg)	16.3	17	14.6	1.4
Vit-C (mg)	54.0	40	35	40
Free folic acid(mic.g)	56.8	100	48.8	100

Table: 6.19 Intake of Nutrients / Day in Adults

Nutrients	Male day	Recommended / day	Female day	Recommended / day
Protein (g)	52.5	60	40.3	50
Total fat (g)	19.0	-	14.3	-
Energy (Kcal)	2208	2875	1734	2225
Calcium (mg)	426	400	328	400
Iron (mg)	12.4	28	9.8	30
Vitamin A (mic.g)	219	600	180	600
Thiamin (mg)	1.5	1.4	1.2	1.1
Riboflavin (mg)	0.7	1.6	0.5	1.3
Niacin (mg)	20.8	18	16.3	14
Vit-C (mg)	55.0	40	42.0	40
Free folic acid(mic.g)	70.6	100	54.6	100

6.12.5. Clinical Examination on Nutritional status:

A total of 1252 infants were examined and the prevalence of clinical cases of marasmus was reported 0.5%. In the pre-school children the prevalence of conjunctival xerosis (0.9%) Bitot spots (0.7%) angular stomatitis was 2.7 % and dental caries was 4.7%.

A total of 830 school age children where examined for the presence of various nutritional deficiency signs. The prevalence of conjunctival xerosis and Bitot spots was 1.1% and 3.1 % respectively. About 3.7% of children had angular stomatitis, 1.2% phyrnoderma, 7% dental fluorosis and 0.5% had goiter. About 6.2% of Adolescents had Bitot spots, 2.4% had angular stomatitis, 7.7% had dental fluorosis and 1.5% had goitre.In case of adults 3556 individuals were examined, 1.9% had Bitot spots, 1.1% had angular stomatitis and 0.9% had goitre.

6.12.6. Anthropometry

Mean and median values of heights, weights, mid upper arm circumference, and fat fold thickness at triceps are presented according to age group and gender

None of the children under the age of 5 years exhibited signs of kwashiorkor, while the prevalence of marasmus was about 0.5%. The prevalence of Bitot spots, an objective sign of vitamin A deficiency and that of angular stomatitis, indicative of B-complex deficiency, was about 0.7% and 2.7% respectively among the preschool children. Among the school age children, the common deficiency signs noted were conjuctival xerosis (1.1%), Bitot spots (3.1%), angular stomatitis (3.7%), prevalence of dental fluorosis was 7.2%.

In general, the proportion of preschool children with underweight (<Median-2 SD) was about 49%. The extent of stunting (<Median-2SD) was about 41%. No significant gender differentials were observed in the prevalence of under nutrition.

At the aggregate level, about 29% of the males and 33% of the females had chronic energy deficiency. The prevalence of overweight was marginally higher among females 25.1% than males 22.5 %.

The mean Haemoglobin levels among adult men and NPNL women (years) were below the cut-off points suggested by WHO to diagnose anaemia. About 29% of adult men and 49% NPNL women were found anaemic.

A total of 798 HHs were covered from 95 villages. Twenty four hours recall method of Diet survey was carried out in a sub-sample of 8-10 HHs covered for nutrition assessment in each village, to assess food & nutrient intakes at HHs and individual levels. All the available individuals were covered for anthropometry.

The dietary surveys revealed that cereals formed the bulk of the diets, while millet consumption was very minimum. The intake of protective foods such as green leafy vegetables, milk & milk products, fats & oils was below the recommended levels both at HHs as well as individual levels. The inadequacy was more among younger age group. It was also revealed that deficiency in the intakes of dietary energy was more pronounced, compared to that of proteins. The intakes of various micro nutrients especially that of iron, Vitamin A, riboflavin & folic acid was grossly inadequate.

The prevalence of underweight and wasting among pre-school children were 49% & 19% respectively. The prevalence of stunting was 41%. The prevalence of over weight of adult men and women were 22.5% & 25.1% respectively.

The study indicated that about **29% male & 49% Female were anaemic, with 6% male & 15% female had moderate to severe anaemia.** The prevalence of Bitot spot (0.7%) among 1-5 year children was more than the WHO cut off level of 0.5%.

6.12.7. Malnutrition

Pre-school children

The overall proportion of children with moderate to severe undernutrition, who were considered as at risk group from public health point of view was observed to be 35%. The prevalence of severe under nutrition was 2.5%. No significant sex differentials were observed in the prevalence of under nutrition.

Malnutrition among School age children and adolescents

The prevalence of underweight was 6.9%, among 6-9 years, 2.5 % in 10-13 years and 9% among 14-17 years.

The prevalence of stunting was 8.9% among 6-9 years, 7.8% in10-13 years and 9.6% among 14-17 years.

The Prevalence of underweight was 67.3% among 10-13 years, 38.7% in 14-17 years age group.

Malnutrition among Adults:

The overall prevalence of Chronic Energy Deficiency was about 30% and 33% among men and women. WHO consultative group (2004) suggested that among Asian Population, individuals with BMI of >23 as a risk factor for coronary artery diseases. According to this, a higher proportion of men (22.5%) and women (25.1%) were found to be having overweight / obesity.

Prevalence of Anaemia :

The overall prevalence of anaemia among adult men was about 29.2% with 5.3 percentages having moderate and 0.5% severe anaemia. The overall prevalence of anaemia among women was about 48.6% with about 14.2% having moderate and 0.8 % severe anaemia.

6.13. CONCLUSION:

About 3114 individuals of different ages from 798 households in 95 villages were surveyed for anthropometry and clinical examination. Sample is drawn as per stratified random sampling technique.

Cereals formed the bulk of the rural dietaries. The consumption of all foods except roots and tubers was below the RDA in all the age/sex/physiological groups. The consumption of protective foods such as pulses, GLV, milk and fruits were grossly inadequate. Consequently, the intakes of micronutrients such as iron, vitamin A, riboflavin and folic acid were far below the recommended levels in all the age groups. Only 18% preschool and 23% school age children were consuming diets adequate in protein and energy.

None of the children under the age of 5 years exhibited signs of kwashiorkor, while the prevalence of marasmus was about 0.5%. The prevalence of Bitot spots, an objective sign of vitamin A deficiency and that of angular stomatitis, indicative of B-complex deficiency, was about 0.7% and 2.7% respectively among the preschool children. Among the school age children, the common deficiency signs noted were conjuctival xerosis (1.1%), Bitot spots (3.1%), angular stomatitis (3.7%), prevalence of dental fluorosis was 7.2%.

In general, the proportion of preschool children with underweight (<Median-2 SD) was about 49%. The extent of stunting (<Median-2SD) was about 41%. No significant gender differentials were observed in the prevalence of under nutrition.

At the aggregate level, about 29% of the males and 33% of the females had chronic energy deficiency. The prevalence of overweight was marginally higher among females 25.1% than males 22.5 %.

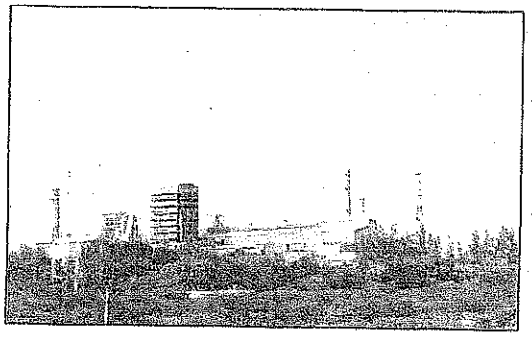
The mean Haemoglobin levels among adult men and NPNL women (years) were below the cut-off points suggested by WHO to diagnose anaemia. About 29% of adult men and 49% NPNL women were found anaemic.

A total of 798 HHs were covered from 95 villages. Twenty four hours recall method of Diet survey was carried out in a sub-sample of 8-10 HHs covered for nutrition assessment in each village, to assess food & nutrient intakes at HHs and individual levels. All the available individuals were covered for anthropometry.

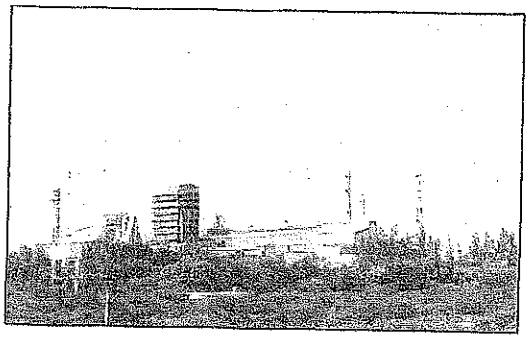
The dietary surveys revealed that cereals formed the bulk of the diets, while millet consumption was very minimum. The intake of protective foods such as green leafy vegetables, milk & milk products, fats & oils was below the recommended levels both at HHs as well as individual levels. The inadequacy was more among younger age group. It was also revealed that deficiency in the intakes of dietary energy was more pronounced, compared to that of proteins. The intakes of various micro nutrients especially that of iron, Vitamin A, riboflavin & folic acid was grossly inadequate.

The prevalence of underweight and wasting among pre-school children were 49% & 19% respectively. The prevalence of stunting was 41%. The prevalence of over weight of adult men and women were 22.5% & 25.1% respectively.

The study indicated that about **29% male & 49% Female were anaemic, with 6% male & 15% female had moderate to severe anaemia.** The prevalence of Bitot spot (0.7%) among 1-5 year children was more than the WHO cut off level of 0.5%.



7. Environmental Factors



7. Environmental Factors

7.1 Rapid Environmental Impact Assessment:

Environmental status study in the study area will give the possible health hazards due to the SIIL and other Industrial operations. This is part of the Epidemiological study, which helps to evaluate the predicted impacts of the various environmental attributes in the health condition of the study area by widely accepted symptoms.

7.2 Land Use and Geographical Studies:

Studies on land use aspects of eco-system play an important role in identifying sensitive geographical health issues.

The land use pattern of the study area has been studied by analyzing the available secondary data such as the District Primary Census Handbooks and Remote Sensing Data.

Table - 7.1 Land Use pattern Based on Remote Sensing Data

Class Names	Area in hectare	Area in percentage
Built-up area	1687.72	5.37
Plantation	361.43	1.15
Crop-land	1826.00	5.81
Fallow land	8954.01	28.49
Land with Shrub	9296.58	29.58
Land without Shrub	4066.86	12.94
Sandy Area	1543.14	4.91
Marsh / Weeds	358.29	1.14
Stony Land	223.14	0.71
Salt Pan	2149.72	6.84
Water body	961.72	3.06
Total	**31428.61**	**100.00**

Fig 7.1 Land Use Map of the Study Area

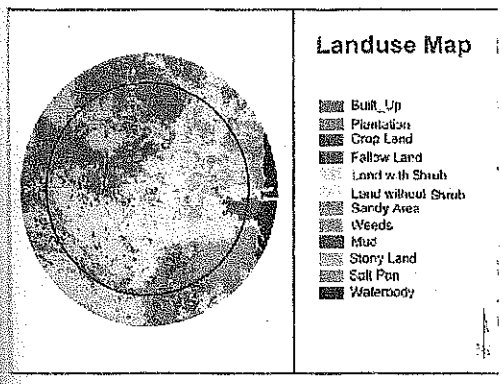


Fig 7.2 Geology of the Study Area

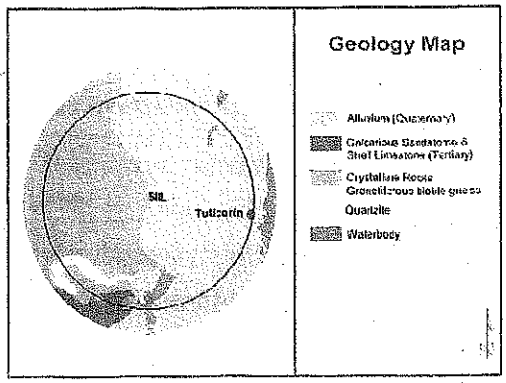


Fig 7.3 Hydro-Geology of the Study Area

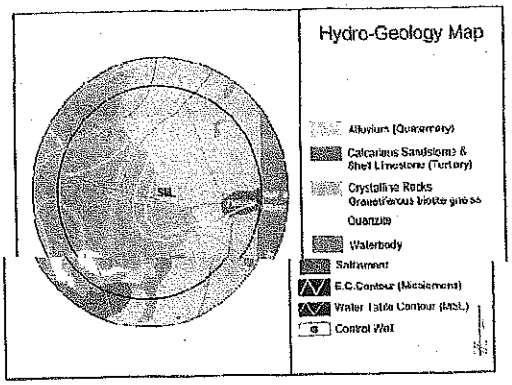
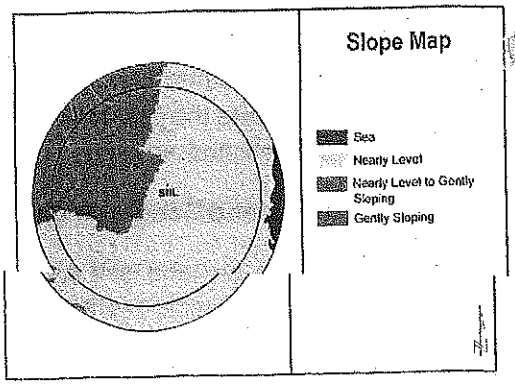


Fig. 7.4 Slope Map



Land Use & Geographical Observations:

1. This study area is not having any forest.
2. In the total study area, the area covered with plantations is 1.15 % only.
3. This study area is occupied by salt pans which is covering 6.84% of total area.
4. The water body area in the study area is found to be 3.06%
5. The geo physical study of this area concludes that these area are covered mostly with alluvium type and crystalline rocks covered with black cotton soil (Cranetlferous biotle gnesis)
6. General Land slope of the area is towards sea; all the natural drainages are moving towards sea in the crystalline rocks area. These natural drainages are not found in alluvium area where it is connected to sea by man made drainages.
7. This area climate is suitable for salt manufacturing due to optimum temperature and High Humidity.
8. This study area is near to sea and the Relative humidity is very high.
9. The average rainfall in these areas are 625 mm / annum

7.3 Meteorology

Historical data on meteorological parameters will also play an important role in identifying the general meteorological related diseases of the region.

The year may broadly be divided into four seasons:

- Winter season : December to February
- Summer : March to May
- South-west Monsoon : June to September
- North-east Monsoon : October to November.

Sources of Information

Secondary information on meteorological conditions has been collected from the nearest IMD station at Tuticorin located at about 10-km from the plant site in the SE direction.

India Meteorological Department (IMD) has been monitoring surface observations at Tuticorin since 1891. Pressure, temperature, relative humidity, rainfall, wind speed and direction are measured twice a day viz., at 0830 and 1730 hr. The wind speed and direction data of IMD, Tuticorin station has been obtained for the past 10 years. The data for the remaining parameters has been collected for the last 10 years and processed. Data on Cloud cover is compiled from the climatological tables from the IMD station at Tuticorin.

Table 7.2 shows the Temperature, Relative Humidity, Atmospheric Pressure and rainfall in Tuticorin.

Temperature

Data is presented as monthly means of maximum and minimum values recorded at 0830 and 1730 hr.

Relative Humidity

Data is presented as monthly means in percentage recorded at 0830 and 1730 hr.

Atmospheric Pressure

Data is presented as monthly means of maximum and minimum values recorded at 0830 and 1730 hr.

Rainfall

Data is presented as monthly totals in (mm).

Table-7.2 Climatological Data-Station : IMD, Thoothukudi

Month	Atmospheric Pressure (mbar)		Temperature (°C)		Relative Humidity (%)		Rainfall (mm)
	0830	1730	Mean Max	Mean Min	0830	1730	
January	1014.1	1010.1	29.6	19.4	78	75	15.8
February	1013.2	1009.1	31.0	20.1	77	73	18.9
March	1012.1	1008.0	33.0	21.9	75	73	36.3
April	1009.9	1006.0	35.2	23.4	73	71	58.6
May	1007.4	1003.9	38.3	24.1	64	62	26.3
June	1007.4	1004.3	38.2	24.1	60	52	3.9
July	1007.6	1004.5	37.3	23.5	59	53	11.3
August	1007.9	1004.5	37.2	23.7	59	55	7.0
September	1009.0	1005.1	37.3	23.6	61	59	14.7
October	1010.5	1006.9	35.8	22.4	72	70	154.4
November	1012.1	1008.6	32.3	21.5	80	76	180.1
December	1013.3	1009.8	30.4	20.1	80	77	98.5

CO & Cu

All the values are in µg/m³.

Location	CO				Cu			
	Max	Min	Avg	98%	Max	Min	Avg	98%
Plant Site (SIPCOT)	528	452	489	527	0.91	0.06	0.33	0.86
TV Puram	466	390	427	465	0.36	0.02	0.19	0.34
Milavittan	467	428	449	466	0.3	0.0	0.2	0.3
Sankaraperi	401	354	385	401	0.4	0.0	0.2	0.3
P. Pandiyapuram	407	372	393	406	0.3	0.0	0.1	0.3
Matattur	407	344	378	405	0.4	0.0	0.2	0.4
Maravanmattam	370	335	355	369	0.4	0.0	0.2	0.4
Sourispuram	303	272	294	303	0.4	0.0	0.2	0.4
Study Area Range	**272-528**				**0.0-0.91**			

Arsenic

All the values are in µg/m³.

Location	Arsenic			
	Max	Min	Avg	98%
Plant Site (SIPCOT)	BDL	BDL	BDL	BDL
TV Puram	BDL	BDL	BDL	BDL
Milavittan	BDL	BDL	BDL	BDL
Sankaraperi	BDL	BDL	BDL	BDL
P. Pandiyapuram	BDL	BDL	BDL	BDL
Matattur	BDL	BDL	BDL	BDL
Maravanmattam	BDL	BDL	BDL	BDL
Sourispuram	BDL	BDL	BDL	BDL

Results and Discussion:

TSPM : Total suspended particulate matter concentrations were observed to be in the range of 61.2-192.4 *µg/m³*. The maximum TSPM concentration was observed at AAQ1 (Plant Site) and minimum was observed at AAQ6 (Matattur).

RPM : Respirable Particulate Matter concentrations were observed to be in the range of 20.3-54.6 *µg/m³*. The maximum RPM concentration was observed at AAQ1 (Plant site) and minimum was observed at AAQ5 (Pandiyapuram).

SO_2: Sulphur Dioxide concentrations were observed to be in the range of 4.2-30.0 *µg/m³*. The maximum SO2 concentration was observed at AAQ1 (Plant site) and minimum was observed at AAQ5 (Maravanmattam).

Results and points for discussion

1. Pandarampatti Thoppu

The sample of water is very hard and the nitrate content is also very high. Heavy metals and trace elements are found to be absent.

2. Meelavittan South Street:

Chemically the water is excessively hard and highly mineralized. The total solid is 2180 mg/ litre and total hardness 710 mg/litre. and sulphate 996 mg/litre are exceeding the maximum permissible limits of 2000 mg/litre, 600 mg/litre, 400 mg/litre respectively as per BIS standard for drinking water. Heavy metal analysis shows the presence of zinc to an extent of 0.7 mg / litre. Chemically at present condition this water is unsuitable for drinking. All other heavy metals are found to be absent.

3. Lucian School Campus:

Chemically it is very hard. Highly mineralized brackish and also contains high amount of sulphate and fluoride. The total solids is 5160 mg / l. Chlorides 1800 mg / l and Sulphates 1078 mg / l exceeding the maximum upper permissible limit of 2000 mg / l, 1000 mg / l and 400 mg / l respectively as per BIS standards.

It also contains abnormally high flouride of 3.6 mg / l which is exceeding the maximum permissible limit of 1.5 mg / l which is 240 %. The heavy metal present in the water is zinc, which is 0.08 mg / l. At present condition, this water is unfit for drinking. Bacteria logically, it is also positive for E. Coli. So, this water is totally unfit for human consumption.

4. Nethaji Nagar IInd Street:

Chemically hardness is very high. Highly mineralized, brackish with high chloride and sulphate content. It also shows high nitrate and nitrogen content. The total solids is of 10550 mg/l. Total hardness of 2700 mg / l. Chlorides 4610 mg. /litre. Alkalinity of 1120 mg/ litre. Nitrate 17.5 mg / litre and sulphates of 1244 mg/ litre, exceeding the permissible limits of 2000 mg / litre, 600 mg / litre, 1000 mg / litre, 600 mg/litre, 11.3 mg / litre and 400 mg / litre respectively as per BIS standard. The heavy metal content is Zinc, which are 0.03 mg / litre.

5. Yogeswar Colony:

This water contains very high concentration of total dissolved solids like chlorides, sulphates. Hardness, would have been either from industrial origin or from sea intrusion. A total solids, hardness, chlorides and sulphates present are unusually very high and exceeding their maximum permissible limits of 2000 mg / litre, 600 mg / litre, 1000 mg/ litre and 400 mg/litre respectively as per the BIS standards for drinking water. The heavy metal present in the sample is Zinc, which is 0.15 mg / litre. The Fluoride content is 1.6 mg / litre, which is just exceeding the permissible limit of 1.5 mg/ litre.

Table : 7.5
Results of Examination of Samples Of Water

Place of Collection			Saminatham	Rajavinkovil	Sillanatham	T.Kumarakiru	Veerapandia puram
Date of collection			05-05-07	05-05-07	05-05-07	05-05-07	07-05-07
Date of Receipt			07-05-07	07-05-07	07-05-07	07-05-07	08-05-07
Bacteriological Examination	Total colonies per ml. agar at 37*C.		120	60	50	70	40
	MPN of Coliform bacteria per 100 ml.		150	0	0	0	0
	Nature of Coliform bacteria isolated(Rapid test for E.coli)		Positive	Negative	-	-	-
	Results of vibrio test		-	-	-	-	-
Physical Examinatio	Colour		Colourless	Colourless	Colourless	Colourless	Whitish
	Turbidity (Units)		5	5	5	5	60
	Smell		None	None	None	None	None
Chemical Examination (in mg/1)	Total solids		2750	1130	3460	2380	2010
	Carbonate hardness as CaCO3		220	272	480	232	207
	Non-Carbonate hardness as CaCO3		620	104	680	868	760
	Total hardness as CaCO3		040	376	1160	1100	960
	Chloride as Chlorine		250	96	580	150	630
	Ammanical nitrogen		Trace	Nil	Trace	Trace	Nil
	Albuminoid nitrogen		Nil	Nil	Trace	Nil	Nil
	Oxygen absorbed (Tidy's test)		1.12	0.80	2.0	0.80	0.56
	Nitrate-nitrogen		4.0	3.0	70.0	20.0	7.5
	Alkalinity as CaCO3	Phenolph thalein	0	0	0	0	0
		Methyl Orange	220	272	480	232	203
	Fluoride as Fluorine		1.0	0.7	0.5	0.6	0.5
	pH.		7.6	7.5	7.1	7.4	6.5
	Iron as Fe		0.05	0.05	0.05	0.05	6.0
	Manganese as Mn.		-	-	-	-	Nil
	Qualitative-						
	Nitrite nitrogen		Trace	Trace	Trace	Trace	Trace
	Sulphate		Marked (1230)	Marked (410)	Marked (830)	Marked (990)	Present (270)
	Phosphate		Trace	Trace	Trace	Trace	Trace
	Toxic substance		-	-	-	-	-
	Electrical conductivity (Peeintocal megnohms cm2 at 20 deg. C.)		9930	1620	4950	3400	2880
	Microscopical Examination		Amorphous matter	Amorphous matter	Amorphous matter	Amorphous matter	Amorphous matter

Results of Examination of Samples of Water

Place of Collection			Kumareddiyapuram	Pandarampatti Thoppu	Moolavittan -South	School campus	Nethaji nagar II St
Date of collection			07-05-07	04-05-07	04-05-07	04-05-07	04-05-07
Date of Receipt			08-05-07	07-05-07	07-05-07	07-05-07	07-05-07
Bacteriological Examination	Total colonies per ml. agar at 37*C.		60	80	60	140	160
	MPN of Coliform bacteria per 100 ml.		0	0	0	0	1100
	Nature of Coliform bacteria isolated(Rapid test for E.coli)		Positive		-	Positive	Positive
	Results of vibrio test		-	-	-	-	-
Physical Examinatio	Colour		Whitish	Colourless	Colourless	Colourless	Colourless
	Turbidity (Units)		60	6	5	5	5
	Smell		None	None	None	None	None
Chemical Examination (in mg/l)	Total solids		1300	890	2180	5160	10550
	Carbonate hardness as CaCO3		232	194	192	440	1120
	Non-Carbonate hardness as CaCO3		08	280	518	12	1160
	Total hardness as CaCO3		840	472	710	460	2700
	Chloride as Chlorine		248	164	360	1800	4610
	Ammanical nitrogen		Nil	Nil	Nil	Nil	Trace
	Albuminoid nitrogen		Nil	Nil	Nil	Nil	Nil
	Oxygen absorbed (Tidy's test)		1.20	0.64	0.96	1.04	3.20
	Nitrate-nitrogen		30.0	10.0	1.5	4.0	17.5
	Alkalinity as CaCO3	Phenolphthalein	0	0	0	0	0
		Methyl Orange	232	184	192	448	1120
	Fluoride as Fluorine		0.5	0.6	0.6	3.6	0.8
	pH.		6.5	7.2	7.3	7.5	7.0
	Iron as Fe		5.0	0.1	0.05	0.1	0.05
	Manganese as Mn.		Nil	-	-	-	-
	Qualitative-						
	Nitrite nitrogen		Trace	Trace	Trace	Trace	Present
	Sulphate		Trace (170)	Marked	Marked (996)	Marked (1078)	Marked (1244)
	Phosphate		Trace	0.123	0.43	0.31	0.31
	Toxic substance		-	-	-	-	-
	Electrical conductivity (Peeintocal megnohms cm2 at 20 deg. C.)		1860	1280	3120	7380	15080
	Microscopical Examination		Amorphous matter	Amorphous matter	Amorphous matter	Amorphous matter	Amorphous matter

Results of Examination of Samples of Water

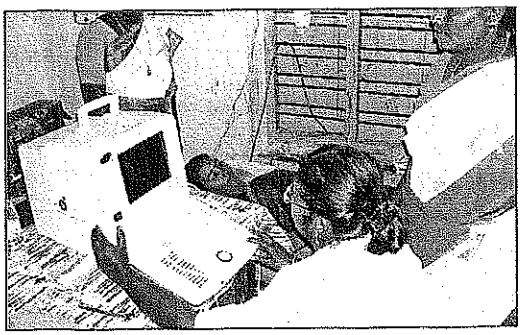
Place of Collection			Yogeshwar Colony	Annai Indira Nagar
Date of collection			04-05-07	04-05-07
Date of Receipt			07-05-07	07-05-07
Bacteriological Examination	Total colonies per ml. agar at 37*C.		70	40
	MPN of Coliform bacteria per 100 ml.		0	0
	Nature of Coliform bacteria isolated(Rapid test for E.coli)		-	-
	Results of vibrio test		-	-
Physical Examination	Colour		Whitish	Colourless
	Turbidity (Units)		7	5
	Smell		None	None
Chemical Examination (in mg/l)	Total solids		23200	3280
	Carbonate hardness as CaCO3		320	480
	Non-Carbonate hardness as CaCO3		6380	1020
	Total hardness as CaCO3		6700	1500
	Chloride as Chlorine		11500	1986
	Ammanical nitrogen		Trace	Trace
	Albuminoid nitrogen		Nil	Nil
	Oxygen absorbed (Tidy's test)		4.08	3.92
	Nitrate-nitrogen		1.0	7.0
	Alkalinity as CaCO3	Phenolphthalein	0	0
		Methyl Orange	320	480
	Fluoride as Fluorine		1.6	1.0
	pH.		6.9	7.4
	Iron as Fe		0.15	0.05
	Manganese as Mn.		-	-
	Qualitative-			
	Nitrite nitrogen		Present	Present
	Sulphate		Marked (2248)	Marked (192)
	Phosphate		0.125	0.61
	Toxic substance		-	-
	Electrical conductivity (Peeintocal megnohms cm2 at 20 deg. C.)		35080	7540
	Microscopical Examination		Amorphous matter	Amorphous matter

7.6 Noise Level Survey

The main objective of noise monitoring in the study area is to establish the baseline noise levels and assess the impact of the noise related health in the study area.

Presentation of Results

The statistical analysis is done for measured noise levels at the following locations. The parameters are analyzed for L_{10}, L_{50}, L_{90}, L_{eq}, L_{day}, L_{night}, and L_{dn}. The statistical analysis results monitored during winter seasons is given in Table-7.8 .These values are well within the prescribed limit of CPCB.



8. Medical Camps

Thirty five medical camps were organized of which 15 were major and 20 small camps. 51687 people have attended the camps and were treated. Four medical camps, two each in the Control Area I and II were also conducted. 3997 were attended the medical camps conducted in the control area I and II.

Minimum 25 doctors including specialists and 40-50 Para medicals have attended the major camps. In the mini mobile medical camps, 5 doctors and 10 Para medicals have attended the camps. The major camps were organized in bigger villages where as the mini camps were organized as mobile medical camps in hamlets. These camps were organized in co-ordination with the local health authorities.

Annexure II shows the categories of the staff engaged in the medical camps

Annexure IV shows the investigations carried out in medical camps

Annexure V shows the lists of equipments used for investigations

Annexure VI shows the list of chemicals the reagents shits used for the camps.

Table 8.1 Medical Camp Performance

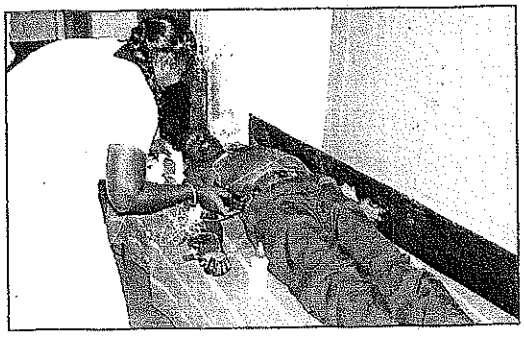
No. of Camps Conducted	Population Covered	Nos. Attended the Camps	No. of Beneficiaries
35	80725	51687	49729

Table 8.2 Medical Camp Performance - Control Area I Dindugul District

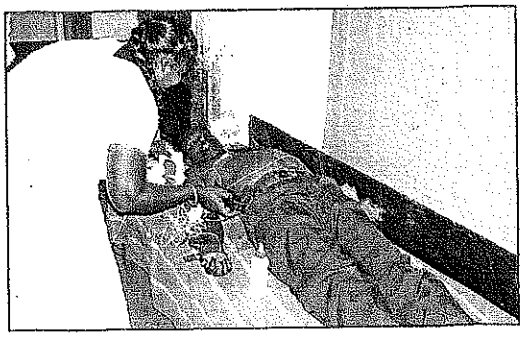
No. of Camps Conducted	Population Covered	Nos. Attended the Camps	No. of Beneficiaries
2	5164	2121	2051

Table 8.3 Medical Camp Performance - Control Area II Ramanathapuram District

No. of Camps Conducted	Population Covered	Nos. Attended the Camps	No. of Beneficiaries
2	4897	1876	1706



9. Morbidity



9. Morbidity

9.5 Gastro Intestinal system:

6.08 % of the people were suffering by Gastro intestinal illness. Predominantly they have colic pain abdominal symptoms. Gastritis is the major gastro intestinal disorder in the survey area. The other major symptom was indigestion and loss of appetite. The deaths due to gastro intestinal disease were 4.2 %. This is almost equal among the male and female.

9.6 Nervous system:

8.91 % have suffered due to nervous disorders. The major disorders are paralysis among the male and headache among the females. The other important symptoms were loss of consciousness, giddiness etc. 5.6 % among the males have tumor in the brain. 12.6% of death was attributed to the nervous system disorders. The major causes of deaths were paralysis and loss of sensation and brain tumours.

9.7 Ear, Nose, Throat & Eye:

4.22 % of the people were having ear, nose, throat and eye problems. Majority of them have visual disturbances and eye problems. 69.4 % among the males, 54.3 % among the female had visual disturbances. 13.1 % among the females were having Cataract and 8.9 % among the males were having cataract. Deafness was high among the females which is 9.2 % when compared to the males it was only 4.8 %. No deaths have been recorded due to the disease of ear, nose, throat and eye at the time of the survey.

9.8 Reproductive and Excretory System:

4.84 % among the females and 1.9 % among the males had the reproductive and excretory problem. 35.5% of the females were having high discharge, back ache and other complications. Among the females, dysfunctional uterine bleeding, different degrees of prolapse of uterine and menstrual problems were reported. 17.4 % among the females were having urinary problems. Among the males 28.9 % were having urinary stones and urinary problems were reported in more than 61 % of the male population. 2.9 % of the male have died due to reproductive and excretory system illness.

9.9 Skin :

2.98 % of the total population had some skin diseases. Itching and urticaria were found in more than 20% of the people. Dark patches were found in 19% of the females and 17 % in the males. There is no loss of sensation in the patch. Fungal diseases are common and equal among male and females which is 14 %. Boils, scabies and ulcers are other major skin disorder observed among the survey population. 16% of the males have some ulcer or other and 13 % among females have ulcers. 0.18 % of the females have warts.

9.10 Dental:

The common dental problems observed are carries teeth, irregular teeth and teeth ache. Caries teeth are more among the males which is 75.8 % and among the females it was 64.8 %.

9.11 Mental Illness:

1.86% among the males and 1.56 % among the females was suffered due to mental disorders at the time of survey.

9.12 Nutritional disorders:

The common nutritional disorders are Vitamin B, A and C deficiency. Vitamin B deficiency among the male are 88% and 50% among the females. Vitamin A deficiency is more common among the males which is 25%, whereas among the females it is 11%. Bleeding gums due to Vitamin C deficiency among the males was 25 %.

9.13 Communicable Diseases:

The known communicable diseases which are common among the survey population are pulmonary tuberculosis, leprosy and sexual transmitted infection. Among the known communicable diseases, major communicable disease is pulmonary tuberculosis both in males and females. Two deaths have been reported among the males due to pulmonary tuberculosis.

9.14 Health status SIIL Employees

The continuous copper rod operations have highest percentage of current smokers. This may be due to just chance but alternative explanation for this can be high occupational stress in this particular department. Counselling for zero tobacco can be an effective tool to safeguard the health of the workers. Tobacco is a very important risk factor as it can increase the toxicity of other occupational toxicants. The number of current smokers is quite high at 21.43 percent. Currently many therapies are avilable to help those people who want to quit smoking. Some of the effective therapies are

1. Dermal nicotine patch
2. Nicotine chewing gums
3. Buspirone
4. Even not tolerating smoking at work place serves as a good deterrent.

The workers employed in continous copper rod operations have the highes percentage of people consuming alcohol. Again this can be an indirect indicator of hig occupational stress prevelant in that field of operation. Although alcohol is not as toxic a tobacco it can reduce the effective income of a household. There should be a system t diagnose people with high levels of alcohol and help them by offering them de-addictio services.

Only 30% of the workers eat fruits on a daily basis. The dietary changes shou incorporate 5-6 servings of fruits per day. The fruit consumption provides the necessary an oxidants which my slow down the oxidant damage unleashed upon the worker's health by t industrial operations.

Only 9% of the workers eat vegetables on a daily basis. The dietary changes should incorporate 5-6 servings vegetables per day. The fruit or vegetables consumption provides the necessary anti-oxidants which may slow down the oxidant damage unleashed upon the oworker's health by Industrial Operations.

28% very few workers are engaged in vigorous activity as a part of their occupation. 37.5% very few workers are engaged in moderate activity as a part of their occupation.

About 66 percent of the workers report at least 10 minutes of walking of cycling. Although it is good but all the workers should at least walk or cycle for 10 minutes per day.

Vey few workers are engaged in vigorous sports. All the workers should at least indulge in at least one day of vigorous sports for at least half hour duration.

Very few workers are engaged in moderate intensity sports. All the workers should at least indulge in at least two days of moderate intensity sports for at least half an hour duration.

On an average worker spend 3.8 hours sitting or reclining each day. If we add the twice of the standard deviation to this figure then it comes to about 8 hours. There should be a break for at least five minutes after every two hours of continuous sitting.

9.14.1 Body habitus of the workers :

Table : 9.1

	BMI Means	BMI Std. Dev.
ACID	22.55	3.48
CCR	22.05	2.91
Control	24.53	4.15
Control 1	24.76	3.46
Field /	23.62	2.99
Lab	21.09	3.23
Office	23.4	4.03
PMB	22.16	3.18
Refinery	22.22	3.32
Smelter	23.6	3.47
All Grps	23.15	3.59

At least 30 percent of the workers have adverse body habitus. This can be well explained by limited exercise, sedentary work style and relative of fruits and vegetables in the diet.

9.14.2. Comparative assessment systolic blood pressure of the workers taking their age as covariate :

Table : 9.2

Group NO->	{1}	{2}	{3}	{4}	{5}	{6}	{7}	{8}	{9}	{10}
Mean Systolic BP	121.21	120.27	121.55	123.43	121.37	119.37	119.16	123.71	119.2	122.11
ACID {1}		0.85	0.93	0.64	0.95	0.58	0.39	0.61	0.51	0.7
CCR {2}	0.85		0.82	0.61	0.82	0.86	0.81	0.59	0.83	0.69
Control {3}	0.93	0.82		0.73	0.96	0.62	0.53	0.7	0.58	0.88
Contol 1 {4}	0.64	0.61	0.73		0.66	0.43	0.35	0.96	0.39	0.77
Field / {5}	0.95	0.82	0.96	0.66		0.54	0.33	0.62	0.46	0.74
Lab {6}	0.58	0.86	0.62	0.43	0.54		0.95	0.41	0.96	0.37
Office {7}	0.39	0.81	0.53	0.35	0.33	0.95		0.33	0.99	0.14
PMB {8}	0.61	0.59	0.7	0.96	0.62	0.41	0.33		0.37	0.73
Refinery {9}	0.51	0.83	0.58	0.39	0.46	0.96	0.37	0.37		0.29
Smelter {10}	0.7	0.69	0.58	0.77	0.74	0.37	0.73	0.73	0.29	

The systolic blood pressure of different groups does not significantly differ.

9.14.3. Comparative assessment of diastolic blood pressure of the workers taking their age as covariate

Table : 9.3

Group NO->	{1}	{2}	{3}	{4}	{5}	{6}	{7}	{8}	{9}	{10}
Mean Systolic BP	71.08	59.49	73.89	71.2	72.52	68.7	71.69	73.75	07.57	71.66
ACID {1}		0.61	0.27	0.97	0.38	0.27	0.69	0.4	0.08	0.7
CCR {2}	0.61		0.23	0.67	0.33	0.82	0.47	0.3	0.56	0.48
Control {3}	0.27	0.23		0.46	0.59	0.07	0.37	0.97	0.02	0.36
Contol 1 {4}	0.97	0.67	0.46		0.66	0.45	0.87	0.53	0.26	0.88
Field / {5}	0.38	0.33	0.59	0.66		0.07	0.57	0.69	0.01	0.55
Lab {6}	0.27	0.82	0.07	0.45	0.07		0.14	0.14	0.64	0.14
Office {7}	0.69	0.47	0.37	0.87	0.57	01.14		0.5	0.02	0.98
PMB {8}	0.4	0.3	0.97	0.53	0.69	0.14	0.5		0.06	0.49
Refinery {9}	0.08	0.56	0.02	0.26	0.01	0.64	0.02	0.06		0.02
Smelter {10}	0.7	0.48	0.36	0.88	0.55	0.14	0.98	0.49	0.02	

The diastolic blood pressure of the refinery workers is significantly lower than the control, field / operation, office and smelter operations. This group of people needs work complementary diet. The fruit or vegetables consumption provides the necessary anti-oxidants which may slow down the oxidant damage munleashed upon the worker's health by Industrial Operations.

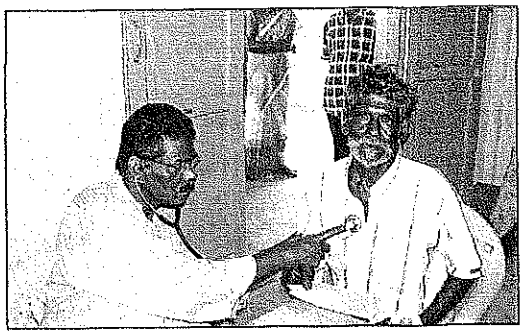
Table : 9.4 Morbidity in Base Line Survey

Sl.No.	System	Study Area	Control Area I	Control Area II
1	**Cardio Vascular System**	%	%	%
	1.1 Chest Pain	6.58	5.45	5.86
	1.2 Febtrilation in the chest	5.98	5.55	5.85
	1.3 Breathlessness	2.96	2.6	2.55
	1.4 Tiredness	0.74	0.75	0.65
	1.5 Edema	0.44	0.4	0.39
	Sub Total	**16.7**	**14.75**	**15.3**
2	**Respiratory System**	%	%	%
	2.1 Cough	3.29	2.46	2.95
	2.2 Cough with sputum	4.12	3.5	3.96
	2.3 Cough with breathlessness	1.74	0.95	1.63
	2.4 Asthma	3.33	2.95	3.25
	2.5 Cough with fever	1.53	1.45	1.43
	2.6 Tuberculosis	0.88	0.75	0.95
	Sub Total	**14.89**	**12.06**	**14.17**
3	**Central Nervous System**	%	%	%
	3.1 Loss of consciousness	1.13	0.26	0.97
	3.2 Giddiness	4.07	4.5	4.7
	3.3 Fits	0.35	0.25	0.32
	3.4 Loss of sensation	0.4	0.23	0.27
	3.5 Paralysis	0.46	0.51	0.86
	3.6 Loss of special senses	0.37	0.2	0.33
	3.7 Headache	2.13	1.16	1.1
	Sub Total	**8.91**	**7.11**	**8.55**
4	**Endocrine System**	%	%	%
	4.1 Symptoms of diabetes	11.25	9.25	10.47
	4.2 Giotre	0.81	1.1	1.05
	4.3 Hyperthyriodis	0.22	0.01	0.25
	4.4 Other endocrine disorders	0.2	0.2	0.2
	Sub Total	**12.48**	**10.58**	**11.97**
5	**Skin**	%	%	%
	5.1 White patch	0.33	0.2	0.3
	5.2 Dark patch	0.63	0.05	0.02
	5.3 Anesthetic patch	0.11	0.1	0.12
	5.4 Boils	0.33	0.35	0.37
	5.5 Warts	0.18	0.01	0.27
	5.6 Ulcers	0.01	0.03	0.29
	5.7 Scabies	0.14	0.17	0.5
	5.8 Fungus	0.5	0.45	0.65
	5.9 Itching	0.74	0.69	0.85
	5.10 Rashes	0.01	0.01	0.3
	Sub Total	**2.98**	**2.13**	**3.67**

Sl.No.	System	Study Area	Control Area I	Control Area II
		%	%	%
6	**ENT**			
	6.1 Deafness	0.51	0.54	0.55
	6.2 Discharge in the ear	0.16	0.13	0.19
	6.3 Ear pain	0.14	1.13	0.16
	6.4 Throat pain	0.38	1.4	0.35
	6.5 Nasal Discharge	0.16	0.05	0.25
	6.6 Nasal Block	0.37	0.15	0.32
	6.7 Sneezing	2.5	2.13	2.65
	Sub Total	**4.22**	**5.53**	**4.47**
		%	%	%
7	**Dental**			
	7.1 Carries Teeth	2.16	2.95	2.25
	7.2 Irregular Teeth	0.14	0.1	0.12
	7.3 Teethache	0.57	1.49	0.56
	7.4 Gum bleeding	0.03	0.04	0.05
	7.5 pyorrhyoea	1.13	1.01	1.3
	Sub Total	**4.03**	**5.59**	**4.28**
		%	%	%
8	**Eye**			
	Cataract	0.79	0.75	0.69
	Conjuncitivitis	0.1	0.01	0.15
	8.3 Visual Disturbances	4.17	4.55	4.07
	Sub Total	**5.06**	5.31	4.91
		%	%	%
9	**Joint & Musculo Skeletol System**			
	9.1 Joint pain	12.02	9.25	10.27
	9.2 Swelling in the joints	1.02	1.1	1.75
	9.3 Inability to move the joints	0.26	0.4	0.57
	9.4 Fracture bone and dislocation	1.09	0.95	1.25
	9.5 Back pain	1.1	1.25	1.01
	9.6 Inability to walk	0.5	0.4	0.65
	Sub Total	**15.99**	**13.35**	**15.5**
		%	%	%
10	**Gastro Intestinal**			
	10.1 Loss of appetite	0.38	2.26	0.97
	10.2 Pain abdomen	3.25	5.05	2.95
	10.3 Nausea and Vomiting	0.24	1.19	0.21
	10.4 Diarroea and dysentary	0.27	1.13	0.27
	10.5 Indigestion	0.53	1.51	0.63
	10.6 Turnour abdomen	0.31	0.01	0.03
	10.7 Constipation	0.27	1.26	0.25
	10.8 Jaundice	0.13	0.11	0.15
	10.9 Piles	0.45	0.35	0.5
	10.10 Hernea	0.25	0.29	0.28
	Sub Total	**6.08**	**13.16**	**6.24**

Sl.No.	System	Study Area	Control Area I	Control Area II
11	**Genito Urinary**	%	%	%
	11.1 Mentrual problems	1.03	1.52	1.04
	11.2 Difficulty in passing urine	0.35	0.82	0.46
	11.3 Painful micturition	0.79	0.56	0.66
	11.4 Incontinence of urine	0.05	0.04	0.07
	11.5 Ureteric stone	0.37	0.52	0.25
	11.6 Leucourea	1.01	0.95	0.85
	11.7 Hydrocele	0.35	0.55	0.47
	11.8 Prolapse uterus	0.15	0.21	0.25
	Sub Total	**4.1**	**5.17**	**4.05**
12	**Phycatric disorders**	%	%	%
	12.1 Mental disorders	1.68	1.67	1.75
	12.2 Alcoholism	1.5	2.59	2.75
	12.3 Drug abuse	0.15	0.25	0.13
	12.4 Obvious mental cases	0.01	0.01	0.01
	Sub Total	**3.34**	**4.52**	**4.64**
13	**Known Communicable diseases**	%	%	%
	13.1 Malaria	0	0.5	1.1
	13.2 Leprosy	0.07	0.1	0.1
	13.3 Vaccine Preventable diseases	0.11	0.1	0.21
	13.4 STI	0.75	0.02	0.55
	Sub Total	**0.93**	**0.72**	**1.96**
14	**Nutritional disorders**	%	%	%
	14.1 Marassmess	0	0	0
	14.2 Vit A deficiency	0.3	0.01	0.2
	14.3 Angiostomatitis	0.18	0.02	0.25
	14.4 Other vitamin defieciency disorders	0.08	0.01	0.02
	Sub Total	**0.29**	**0.04**	**0.29**

Sl.No.	System	Study Area 2006	Control Area 2005 Dindigul	Study Area II Ramnad	State (2005)
6	ENT	%	%	%	%
	6.1 Hard of Hearing	0.75	0.62	0.75	0.51
	6.2 Otitis Media	1.45	1.03	1.05	1.36
	6.3 Rhinitis	1.45	1.57	1.08	1.03
	6.4 Nasal Polyps	0.14	0.1	0.17	0.13
	6.5 Septum Deviation	0.2	0.17	0.25	0.2
	6.6 Tonsillitis	1.5	0.72	0.75	0.72
	6.7 Pharyngitis	7.5	5.04	0.65	6.63
	6.8 Sinusitis	2.56	2.1	2.2	2.65
	6.9 Other Diseases	1.07	1.05	1.3	1.22
	Sub Total	**16.62**	**12.4**	**14.2**	**14.45**
7	**Dental**	%	%	%	%
	7.1 Dental Carriers	1.66	2.68	2.5	2.75
	7.2 Gingivitis	0.55	0.56	0.53	0.43
	7.3 Periodontitis	0.39	0.41	0.35	0.32
	7.4 Dental Malformation	0.15	0.13	0.1	0.12
	7.5 Dental Occlusion	0.06	0.05	0.08	0.1
	7.6 Dental Moting	1.06	1.01	1.02	1.5
	7.7 Others	1.16	1.45	1.32	1.22
	Sub Total	**5.03**	**6.29**	**5.9**	**6.44**
8	Eye	%	%	%	%
	8.1 Refractory Error	3.55	3.58	3.62	3.82
	8.2 Cataract	2.06	0.26	2.1	2.05
	8.3 Conjunctivits	0.25	0.66	0.2	0.86
	8.4 Style	0.33	0.3	0.25	0.3
	8.5 Glaucoma	0.35	0.53	0.6	0.55
	8.6 Others	2.15	11.79	5.15	9.81
	Sub Total	**8.69**	**17.1**	**11.92**	**17.39**
9	**Joint & Musculo Skeletal System**	%	%	%	%
	9.1 Osteo Arthritis	4.63	4.04	3.3	3.5
	9.2 Myalgia	8.46	6.62	7.1	7.33
	9.3 Locomotor Disability	1.05	0.82	0.7	0.53
	9.4 Lumbago	4.56	5.5	5.3	5.25
	9.5 Others	0.7	1.22	1.2	0.92
	Sub Total	**19.4**	**18.2**	**17.6**	**17.53**



10. Summary of Prevalent Diseases

Cardiovascular System:

Under this system, the study focused the prevalence of streptococcal infection related rheumatic heart diseases among the children and chronic non-communicable diseases like hypertension and IHD. Investigations were also carried out to find out the prevalence of blood disorders like unusual increase of bleeding disorders, leukemia influenced by extraneous factors.

Among the targeted diseases, only hypertension was slightly on the higher side which was 1.5%. In Tamil Nadu state, the projected prevalence rate is 1.31%. The slight increase in the prevalence may be due to the life style factors among the study population and personnel habits of smoking, alcoholism and sedentary life styles. There was no abnormality in the blood disorders when compared with the control areas. There were no extraneous factors influencing on the circulatory and cardiovascular system.

However, regular awareness campaign on prevention of hypertension, IHD among targeted groups, hygiene practices among school children may be carried out.

Respiratory System:

In the study population, at the time of survey it was observed a high prevalence of respiratory tract infections. 9% of the people who had attended the Medical Camps had signs of both upper and lower respiratory tract infections. This also correlates with the symptoms enumerated during the survey. The symptoms elicited during the survey and their proportions are cough 3.29%, cough with fever 1.53%, cough with sputum 4.12% and cough with breathlessness 1.74% and asthma 3.33%.

Respiratory morbidity in control areas I & II and state is less when compared to the study area. These diseases are not classifiable under pneumoconiosis.

2.8% had asthmatic bronchitis, whereas it was 1.19%, 1.46% and 1.29% in control area I, II and state respectively.

Pulmonary tuberculosis was less than 1% which is a critical level of transmission but the prevalence rate of 0.69% is slightly high when it is compared with the control areas and state figure.

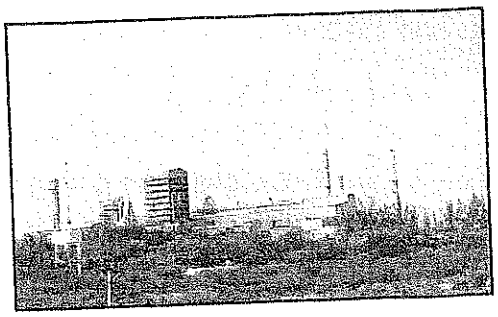
The attributable cause is due to air pollution signifies the presence of gases, mixture of gases and particulate matter.

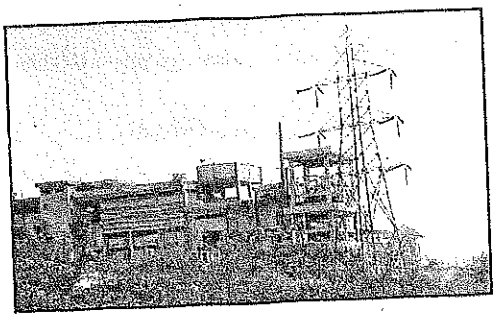
Automobiles are found to be another major source of air pollution in the study area. They emit hydrocarbons, carbon monoxide, lead nitrogen oxides and particulate matter. In sun light some of these hydrocarbons are converted in the atmosphere into photochemical pollutants of oxidizing nature. In and around SIIL, large numbers of trucks and other heavy vehicles are moving (Fig-10.3). Badly adjusted diesel engines when misused are capable of emitting black smoke and malodorous fumes which may cause respiratory tract infections.

Figure 10.1 Movement of Trucks and Other Heavy Vehicles

The sources identified by the survey in the area include the industries listed in the Annexure VIII emit pollutants in the atmosphere. Combustion of fuel to generate heat and power produce smoke, sulphur dioxide, nitrogen oxides and fly ash. Petrochemical industries generate nitrogen fluoride, carbon monoxide, carbon dioxide, ozone hydrogen sulphide etc., Industrial Operation is shown in the fig. 10.2.

Figure: 10.2 Industrial Operation





In both control areas I and II, it was found that the vehicle population is significantly much less when compared to the study area.

At times, the high level of respiratory infections also depends upon certain meteorological factors like topography, air movement and climate. The wind velocity in this area is of not much helpful in the dispersal and dilution of the pollutants.

Recommendations for Control and Prevention:

Skin Diseases:

In total, the skin morbidity was not a significant feature in the area. The skin morbidity was 5.39% which is less when compared with control area I (Dindigul) and also equal with state and slightly less when compared with control area II where it is 5.9%. More attention was paid on the prevalence of skin cancers, which is only 0.3%. Generally, skin cancers are reported in studies caused by coal tar, X-rays, certain oils and dyes and arsenic. In this study, there were no cases of skin cancer caused by arsenic or any other chemicals. However,

eczematous skin lesions were high (1.38%). Other infectious skin lesions like, impetigo, fungal infections and leprosy are insignificant in the study area.

Other major prevalent diseases were myalgia (body pain) 8.46%. For this nonspecific cause could be ascertained. General complaints of body pain are very common in any community at point of time. Females are having this problem more than males in any areas. Acid Peptic Diseases was also high (7.45%) when compared to control area I and II, which could be due to high consumption of alcohol in this area. Personal motivation and inter personnel communication with the members and family and proper counseling will reduce the problem.

Females in the area had more menstrual disorders, like menorrhagiae, dysmenorrhagiae etc. Exact cause for this was not able to find out. However, it needs an in depth study.

Among the nutritional disorders, anemia appears to be high among the females and children when compared to the state figures and control area I. This problem could be controlled by nutritional education and awareness on the nutritional programmes like prophylaxis anemia control programme for pregnant women and adolescent girls.

Any specific diseases related to Industrial Hazards and known causes

Diseases caused by the industries are health hazards due to environmental pollution.These hazards are classified in to two major groups

i) Acute
ii) Chronic

The acute hazards are mainly by the toxic gases released in the air and consumption of water with toxic substances contaminated the water. The good example is the accidental release of Methyl isocyanide, lethal gas from the carbide industry at Bhopal on 3rd Dec 1984 in which more than 2000 people died instaneously. Other examples reported in the media are the Chernobyl disaster in Russia where there was accidental atomic radiation causing hundreds of deaths. Some times, release of poisonous gases causes irritation of the eyes, headache, giddiness and loss of consciousness, nausea, vomiting etc.

In case of acute contamination of water, the people will get colicky pain in the abdomen, bad taste in the mouth, nausea and vomiting. Within a few hours they will have diarrhea and painful defaecation. They will lose the appetite and feel tired.

Persistent organic pollutants (POPs) are known carcinogens. Eg. Organochlorines, dyes, chemicals.

For the first time in his entire cultural history, man is facing horrible ecological crisis. The problem of pollution in the environment is especially due to toxic pollutants from industries. Industrial pollution affects flora, fauna and other whitic components of the eco system.

There are small scale industries in the SIPCOT industrial complex of Thuthukudi. Apart from these, there are 11 medium and large scale industries in Thuthukudi. These industries are mainly food processing, chemical fertilizers, yarn and thermal power producing units. Thuthukudi port is the second largest port in Tamil Nadu handling bulk cargo of food grains, coal, fertilizers etc.,

Children and infants are among the most susceptible to many of the air pollutants, because 80% of alveoli are formed postnataly and changes in the lungs continue through adolescence. Numerous studies have shown that outdoor air pollution exacerbates asthma but it is less clear on the pathogenesis. In areas with high levels of ozone, there was an increased risk of developing asthma in a small subset of children involved in 3 or more sports (Relative risk 3.3 at 95% confidence interval). However, additional studies are needed to define the role of outdoor air pollution in the development of asthma.

The health status of the SIIL workers report shows there is no significant incident or prevalence of occupational industrial hazards among the workers.

Arsenic related diseases and Risk factors in and around 5 km of SIIL:

Arsenic poisoning or its related diseases are from drinking water sources especially of from deep bore wells. It is estimated that, 330 million people are at risk in India and the first case was reported in India in 1983 in West Bengal. Typical Neuropathy and skin lesions were the common diseases due to arsenic poisoning.

Symptoms:

The common symptoms of arsenic poisoning from reported literatures are violent stomach pain, tenderness, nausea, vomiting, dryness of mouth, hoarseness of voice. The vomitus may contain blood or it may be greenish or yellowish in colour, diarrhea, tenesmus dysurea, cramps, convulsions, delirium, and neuropathy. All these symptoms start with headache.

Potency:

The LD50 for pure arsenic is 763 mg/kg (by ingestion). For 70 kg human, it works out to be 53 grams. All arsenic poisonings reported were not due to pure arsenic, but by oxygen compound, especially arsenic trioxide, which is 500 times more toxic than the pure Arsenic.

Chronic arsenic poisoning results from drinking arsenic contaminated water for a long period commonly from ground water sources. The effects include changes in skin colour, dark patches on the skin, skin cancer, lung cancer and bleeding gangrene. WHO recommended a limit of 0.01 mg/L (10ppm) keeping in mind on the item of work order, survey and analysis was carried out to identify the prevalence of symptoms related to arsenic poisoning.

Dermatologists in the team who have examined the skin cases opined that none of the cases had the signs and symptoms of Arsenic poisoning. All the skin diseases are of routine in nature and do not resembles those symptoms reported in literatures in Arsenic poisoning.

The above findings are also correlated with the water sample analysis in which there were not even traces of Arsenic in the ground water.

Conclusion:

Health status and Epidemiological survey findings show that there are no signs and symptoms of Arsenic poisoning among the population surveyed around 5 km radius of SIIL. Samples of bore well water also show the absence of Arsenic in the samples of water during the survey.

11. Conclusion and Recommendations

Conclusion

There are sixty seven functional industries in the SIPCOT Complex. There major industries like SPIC (Southern Petro Chemical Industries Corporation) a (Tuticorin Alkaline Chemicals) near the Port. Most of the small scale industries are r sea food processing and iodised salt manufacturing units and there are some units various activities. SIIL, Thuthukudi is one of the major industry which produces copp sulphuric acid & phosphoric acid.

Community Medicine Department of Tirunelveli Medial College has carri Health status and Epidemiological study around 5 km radius of SIIL, Thuthukudi with permission of the Director of Public Health and Preventive Medicine, Govt. of T

The main objective of the study was to find out the health status of the peo and around 5 km radius of SIIL. Their health status was compared with the health people living in two control areas. Control area I was a plain area where t industries. Control area II was selected in the mid course of the study on the re funding agency. This is a sea shore area similar to the study area but without in control area I was located in Attoor PHC in Dindigul district and control II Rameshwaram in Ramanathapuram District. Both the areas were selecte sampling, listing out the control areas and also considering the feasibility Inclusion of control area were aimed to find out, if there is any difference in the d (morbidity) in the study area and control area and if there is any difference to find and recommendations to reduce the incidence and prevalence of diseases in c

This study was carried out in four phases. In the first phase, recrui seminars, workshops and advocacy meetings were conducted. A base line sur out in the second phase followed by medical camps in the 3rd phase and finally compilation, analysis and report preparation.

Quiet sufficient number of well qualified, experienced medical a personnels and experts were hired for this study. Standard formats were us the survey and medical camps.

Eighty seven diseases were identified from ICD list keeping in diseases based on the objectives of the study.

Eighty one villages with a population of 60527 were initially propos study but 95 villages with a population of 80725 were covered. This coverage of 17.2% more villages and 33.3% more than the targeted popul

As far as socio economic status is concerned, 79% of the popul study area was in class II categories and 17% are in class III and only 4% a of the population belongs to Hindu religion in which 29.5% of the p scheduled caste.

The literacy rate is very high (80%) when compared to the state average which is only 64.4%.

Nutritional status is a very important component of the health status of the community. This was carried out as per the National Nutritional Monitoring Guidelines of National Institute of Nutrition, Hyderabad.

Morbidity was assessed by survey based on symptomatology and clinical assessment. Important diseases were confirmed by appropriate investigations. Thirty five medical camps in the study area and four medical camps two each in the control I & II were conducted. 96% of the people in the study area were benefited.

Eighty seven targeted diseases were grouped under fourteen systems of the body. Among the system involvement, respiratory diseases were more prevalent in the study area i.e., 13.9% which was significantly less in the control areas I, II and state. The detailed report is available in the appropriate title. The increased prevalence rate of asthma and respiratory infections are due to the air pollution caused by the industries and automobiles in the area. Thousands of trucks and other heavy vehicles are passing through the study area everyday for handling of cargo from the Thuthukudi port, which is an added significant factor for this problem.

Other interesting observation of this study was the higher ENT morbidity (16.6%) which was higher than the control areas and state data. Among the ENT diseases, pharyngitis and sinusitis were very high. Climatic conditions and atmospheric pollution could be the cause for the higher prevalence of ENT morbidity.

There was a marginal increase of non communicable diseases like cardiovascular diseases and diabetes mellitus. These diseases are mainly due to the life style of the people in the area. It was observed that, a high prevalence of smoking and alcoholism in the study population which contribute the high prevalence of cardiovascular diseases.

The marginal increase of musculo skeletal disorders (19.4%) was due to the increased proportion of old age in the area having osteoarthritis and myalgia. Acid peptic diseases (7.5%) could be due to high intake of alcohol in the study population. The reasons for the high prevalence of menstrual disorders (1.06%) among the women are not known which needs specific study.

Eye diseases were less when compared to the control areas I, II and the state. This was 8.7% which is significantly very low. Skin disorders were not significantly high except eczema (1.38%). Skin cancers due to carcinogens are ruled out. Anaemia was 5.1% which was also high in control area II, when compared to state figure.

The second group of diseases which was less when compared with the control area and state are the Dental diseases. Dental carries was less among the children in the study area (1.6%) which was high in the state (2.75%). The attributed cause may be due to good dental hygiene practices in the area.

Parasitic diseases were only 2.3% which was very less when compared with the state figure (6.04%) and also in control I (5.1%) and in control area II (5.5%). In fact, Mappilaivurani PHC area is a known endemic area for malaria, where in out of the 3100 blood smears collected only, five smears showed *Plasmodium vivax* malaria. Similarly, parasitic intestinal helminthes also showed less proportion when compared to the state and control area I and II figures. The reasons for the less proportion of parasitic diseases may be due to improved socio economic status, good personnel hygiene practices, increased literacy level etc., The state figure shows a very high prevalence of helminthes infestations (4.85%) in the gut because the figure included the morbidity of many of the non industrialized backward districts.

Recommendations:

WHO (1987) in its publication has recommended approved methods of determining the concentration of common air pollutants and their health hazards. The emphasis in the guideline is placed on duration exposure since it can lesser the dose and hence lessons the response. So it is suggested that long term air quality monitoring has to be done in this area. Pollution control board has fixed the standard limits for Suspended Particulate Matter (SPM).

Ultimately the control measures are a collective responsibility of the Government, Industries and the Community. Containment could be achieved by means of engineering methods by the Industries. Replacement is also a possible method by which the industries can adopt or replace a technology causing air pollution.

All the industries in the are a may join together under one "consortium" through which many of the health related service activities could be carried out in the area.

This consortium should make an annual plan of activities on the following

1. Periodic medical and health check ups in the area
2. Health education and promotion activities
3. Regular and periodic monitoring of the environmental parameters
4. Involvement in developmental activities in the area
5. Participating in the cultural and religious festivals in the area
6. Provisions of emergency medical care facility
7. Under public private partnership, adaptation of the existing health institutions and educational institutions in the area
8. Generating a revolving fund for the education of the SC/ST children in the area.

Annexure

Annexure-I

List of Villages and Population selected for Survey

District : Thoothukudi

Block : Thoothukudi

Sl.No.	Name of the Village	No. of Houses	Population
1.	Sankaranbery North	80	338
2.	Sankaranbery South	125	578
3.	Pandarampatti	366	1485
4.	Meelavittan	233	880
5.	Kakkan Nagar	94	385
6.	Loosiyan Nagar	21	105
7.	Silvarpuram	125	480
8.	Submaniyapuram	81	380
9.	Balaihyapuram	64	275
10.	Rajagopal Nagar	475	2380
11.	Mazhillchipuram	158	625
12.	Chinnakannupuram	135	590
13.	Eswapuram	155	675
14.	VMS Nagar	92	380
15.	Annai Indra Gandhi Nagar	215	880
16.	Iyyappan Nagar	178	760
17.	Nethaji Nagar	138	558
18.	Kasirajan Nagar	112	448
19.	Madathur	417	1670
20.	Railway Colony	42	180
21.	SIPCOT Colony	54	220
22.	Amulya Quarters	17	115
23.	EB Colony	25	90
24.	Sundaram Nagar	50	320
25.	Duraikani Nagar	58	240
26.	Murugesan Nagar	60	350
27.	P&T Colony	688	2932
28.	Kokur	179	842
29.	Asirvatha Nagar	125	458
30.	Rajiv Nagar	198	850
31.	Kathivel Nagar	215	960
32.	TNHB Colony (Milavattan)	449	1871
33.	Burma Colony & Anthoniyapuram	149	625
34.	Pudukudiyiruppu	510	2190
35.	Vallinayagapuram	301	1296
36.	S.N.R. Puram	160	640
37.	Ganesan Colony	300	1420
38.	Amudhan Nagar	296	1217
39.	Shanthi Nagari	163	675
40.	Kuruvimedu	112	470
41.	Ganesh Nagar	167	890
42.	NGO Colony	84	340
43.	Munusamy Nagar	78	330

Sl.No.	Name of the Village	No. of Houses	Population
44.	Indira Nagar OPP to FCI	279	1129
45.	Thiru Vee.Ka. Nagar	195	780
46.	Muthammal Colony	552	2070
47.	Mappillaiyurani	261	1050
48.	Thalavaipuram	62	250
49.	Omsakthi Nagar	60	250
50.	Korampallam	470	1881
51.	Kalankarai	171	684
52.	Anthoniyapuram	237	1148
53.	Maravanmadam	190	760
54.	Thiraviapuram	172	810
55.	Perianayagipuram	303	1210
56.	Ayynandaippu	64	256
57.	Kailasapuram	90	361
58.	Sanmugapuram	26	79
59.	Rajapandi Nagar	20	84
60.	Vadakkusilukanpatti	83	342
61.	Madhavan Nagar	190	756
62.	Soreespuram	107	441
63.	Indra Colony	312	1235
64.	Pallapuram	60	240
65.	Pulipanchankulam	90	350
66.	Viswapuram	145	575
67.	Thevar Colony	225	897
68.	Mullikulam	200	800
69.	Ayyan Odaippu	64	256
70.	Soosaipuram	419	1676
71.	Madhavan Nagar	190	259
72.	Ramachandrapuram	83	342
	Total	**12,832**	**53,933**

District : Thoothukudi **Block : Ottapidaram**

Sl.No.	Name of the Village	No. of Houses	Population
73.	Sillnatham	211	845
74.	Nainarpuram	158	631
75.	Puthur Pandiyapuram	215	860
76.	Swaminatham	205	822
77.	Rajavinkovil	121	485
78.	Velayuthapuram	173	693
79.	Therku Veerapandiyapuram	158	633
80.	Kumarrediyapuram	199	478
81.	T. Kumaragiri	76	303
	Total in Ottapidaram	1516	5740
	Total in Thoothukudi	12832	53933
	Total	**14348**	**59673**

Annexure-II

List of personnel engaged in the Medical Camp

Sl.No.	Name of the Individual	Designation	Name of the PHC
1	Dr.C.Selvakumari	DDHS	Kovilpatti
2	Dr.A.Liaquat Ali	DDHS	Thoothukudi
3	Dr.D.Sobana	Medical Officer	Mapillaiyurani
4	Dr.Caroline	Medical Officer	Pudukottai
5	Dr.M.Santhanamar	Medical Officer	Mullakadu
6	Dr.E.Praveenkumar	Medical Officer	Mudivaithanendal
7	Dr.N.Dharmaraj	Medical Officer	Attoor
8	C.Manthiram	District Entomologist	O/o DDHS, Thoothukudi
9	V. Subbulakshmi	Asst. Director (SBHI)	O/o DDHS, Thoothukudi
10	T. Gunaseelan Pattubai	District Maternal & Child Health Officer	O/o DDHS, Tirunelveli
11	V.A.Sathiyanesan	Non Medical Supervisor	Pudukottai
12	N.Shankar	Scientist	Aakam, Madurai
13	P.Arumugam	Statistician	Tirunelveli
14	N.Duraisamy	Health Educator	Dindugul
15	C.Prema	Community Health Nurse	Pudukottai
16	S.Madhavi	Community Health Nurse	Eral
17	AV.Mallika	Sector Health Nurse	Mudivaithanental
18	R.Ramuthai	Sector Health Nurse	Puthian Puthur
19	G.Panjavarnam	Sector Health Nurse	Arumuganeri
20	G.Vasanthara	Sector Health Nurse	Mudivaithanendal
21	K.Chandra	Sector Health Nurse	Mullakadu
22	R.Maria Juliet	Sector Health Nurse	S. Kailasa Puram
23	A.Chandra	Village Health Nurse	Mudivaithanendal
24	J.Sheeba	Village Health Nurse	Mudivaithanendal
25	J.Sheeba	Village Health Nurse	Mudivaithanendal
26	M.Sinthu athima	Village Health Nurse	Mudivaithanendal
27	I.Jeyasundari	Village Health Nurse	Mudivaithanendal
28	S.Anthoniammal	Village Health Nurse	Mullakadu
29	R.Komalavathi	Village Health Nurse	Mullakadu
30	M.Vijili Fernado	Village Health Nurse	Mullakadu
31	K.Sooriya parameshwari	Village Health Nurse	Mappilaiyurani
32	S.Anna Selvam	Village Health Nurse	Mappilaiyurani
33	S.Mahalaskhmi	Village Health Nurse	Mappilaiyurani
34	N.Veronica	Village Health Nurse	Mullakadu
35	P.Malaiammal	Village Health Nurse	Pudukottai
36	S.Heera	Village Health Nurse	Pudukottai
37	G.Nagavalli	Village Health Nurse	Pudukottai
38	S.Sudalaimani	Village Health Nurse	Mullakadu
39	S.Kala	Village Health Nurse	Pudukottai
40	M.Petchiammal	Village Health Nurse	Mappilaiyurani

Sl.No.	Name of the Individual	Designation	Name of the PHC
41	P.Maheshwari	Village Health Nurse	Pudukottai
42	V.Subbulakshmi	Village Health Nurse	Puthian Puthur
43	P.Rajalskhmi	Village Health Nurse	Puthian Puthur
44	M.Lalitha	Village Health Nurse	S. Kailasa Puram
45	J.Ponnammal	Health Inspector	Mapillaiyurani
46	J.Berchmans	Health Inspector	Mudivaithanendal
47	S.Aiyappan	Health Inspector Gr. I	Mullakadu
48	S.Balasubramanian	Health Inspector Gr IB	Sebathiapuram
49	S.A.Iyyappan	Health Inspector Gr I	Mappilaiyurani
50	S.Jayakanthan	Health Inspector Gr I	Pudukottai
51	R.Peter Bash	Health Inspector	Mullakadu
52	M.Mohideen	Health Inspector	O/o DDHS, Thoothukudi
53	C.Ananthan	Health Inspector	Mappillaiyurani
54	R.Sivaram	Health Inspector	Mullakadu
55	A.Mathivanan	Health Inspector	Pudukottai
56	K.Paul Raj	Health Inspector Gr IB	Pudukottai
57	M.Dharanee	Health Inspector Gr IB	Mullakadu
58	P.James Fernando	Health Inspector Gr IB	Pudukottai
59	S.Elango Rajan	Health Inspector Gr IB	Pudukottai
60	N.Srinivasan	Health Inspector	Mappillaiyurani
61	P.Antony Sandi	Health Inspector	Mappillaiyurani
62	N.Esakki	Health Inspector	Mudivaithanendal
63	M.Rambola	Health Inspector	Mappillaiyurani
64	S.Periyasamy	Health Inspector Gr IB	Mullaikadu
65	P.Shanmugasundaram	Health Inspector Gr I	Mappillaiyurani
66	A.Kandasubramanian	Health Inspector Gr IB	Mappillaiyurani
67	J.Ponnuraj	Health Inspector	O/o DDHS, Kovilpatti
68	R.Marichamy	Health Inspector	Villiseri
69	A.Genova	Health Inspector	Puthian Puthur
70	P.Ganesan	Health Inspector	Keela Iral
71	N.Thangaraj	Health Inspector	Keela Iral
72	N.Thanga Raj	Health Inspector	Keela Iral
73	P.Santhana Raj	Health Inspector	Pasuvantharai
74	M.Venkatesh	Health Inspector	O/o DDHS, Chennai - 6
75	S.Murgaraj	Health Inspector	Nagalapuram
76	V .Karunanithi	Health Inspector Gr IB	Kedampur
77	B.Shanmugasundaram	Health Inspector Gr IB	Erachi
78	V.Sadurappan	Health Inspector Gr IB	Erachi
79	S.Paul	Health Inspector Gr IB	Erachi
80	V.Krishnan	Health Inspector	
81	S.Subramanian	Superintendent	O/o DDHS, Thoothukudi
82	G.Sivasubramanaian	Junior Asst.	O/o DDHS, Thoothukudi
83	M.Arumugam	Assistant	O/o DDHS, Thoothukudi

Date (DD/M/YY) / / 06

Health Status and Epidemiological Study

(Household General)

Form - I

FORMNO

DISTRICT | HUD | BLOCK | VILLAGE

DOOR NO | STREET

INFORMER NAME

RELIGION 1. HINDU 2. MUSLIM 3. CHRISTIAN 4. OTHERS

SOCIAL CLASS 1. OC 2. BC 3. MBC 4. SC 5. ST

MEMBERS IN THE HOUSE

MEMBERS IN THE HOUSE	SL.NO.	NAMES	RELATION	SEX	AGE	MARITAL STATUS	EDUCATION	OCCUPATION	ANNUAL INCOME	ILLNESS	PHYSICAL DISABILITY	PERSONAL CHARACTERISTICS: SMOKER	SNUFF	PAN	

RELATION : 01. HEAD / 02. FATHER/ 03. MOTHER / 04. WIFE / 05. SON / 06. DAUGHTER / 07. BROTHER / 08. SISTER / 09. IN LAWS / 10.GRAND PARENT / 11 GRAND CHILDREN / 12. GUEST SEX: 1. Male / 2. Female
AGE: Completed Years; If les than 1 year write '000' MARITAL STATUS: 1. Married / 2. Unmarried OCCUPATION: 1. Private / 2. Self / 3. Government / 4. Unemployed ILLNESS : 1. Yes / 2. No
EDUCATIONAL STATUS: 1. Nil / 2. 1 to 5th / 3. 6th to 8th / 4. 9th to SSLC/10th / 5. HSC / 6. Under Graduate / Diplomas / 7. Post Graduate / 8. Professional Engineering / 9. Professional Medicine / 0. Professional Others
ANNUAL INCOME: 1. Up to Rs.6000/= / 2. Rs.6001 to Rs.12000/= / 3. Rs.12001 to Rs.25000/= / 4. Rs.25001/= to Rs.50000/= / 5.Rs.50001/= to Rs.100000/= / 6. Rs.100001 and above
PHYSICAL DISABILITY: 1. Blind / 2. Deaf / 3. Dumb / 4. Physically Handicapped / 5. BD / 6. Others PERSONAL CHARACTERISTICS: 1. Smoker / 2. Snuff / 3. Pan / 4. Alcohol

1869600651

FORMNO

HOUSE TYPE ○ RCC ○ TILED ○ HUT	HOUSE ○ OWN ○ RENT ○ LEASE	NO OF ROOMS	LIGHT ○ EB ○ KEROSENE ○ OIL	WATER ○ DOMESTIC ○ PUBLIC SOURCE ○ BOREWELL ○ TAP ○ WELL ○ POND ○ RIVER
COOKING FUEL ○ LPG ○ KEROSENE ○ WOOD ○ OTHERS	KITCHENWARE ○ CLAY ○ ALUMINIUM ○ STAINLESS STEAL		TOILETS IN THE HOUSE ○ SEPTIC TANK ○ NO ○ OPEN ○ COMMUNITY ○ SERVICE ○ SHARED	SOLID WASTE DISPOSAL ○ OPEN ○ DUST BIN ○ COMPOST
SEWAGE ○ PUBLIC DRAIN ○ KITCHENGARDEN ○ LET OUT ON THE STREET	OWNS AGRI LAND ○ Yes ○ No IF YES ○ WET ○ DRY ○ BOTH		VEHICLES ○ Yes ○ No	IF YES ○ Cycle ○ Tractor ○ Two Wheeler ○ Auto ○ Car ○ Bullock Cart
ANIMALS / BIRDS ○ Yes ○ No IF YES ○ Live stock ○ Pet animals	OTHER AMENITIES ○ TV ○ AC ○ RADIO ○ PHONE ○ FRIDGE ○ CELL ○ FAN ○ COMPUTER ○ COT/BED		FOOD ○ VEG ○ NON-VEG	REGULARITY OF NON-VEG ○ DAILY ○ FREQUENTY ○ WEEKLY ○ MONTHLY ○ OCCASSIONALY

SICK PERSON'S DETAILS

If 'YES' in, ILLNESS COLUMN UNDER HEAD "MEMBERS IN THE HOUSE"

SNO	NAMES	SEX	AGE	OCCUPN	DURATIOOF ILLNESS	PLACE OF TREATMENT	SYMPTOMS CODE

0976600659

DURATION OF ILLNESS: 1. Within 7 Days / 2. 8 - 15 Days / 3. 16 to 30 Days / 4. One month to 1 Year / 5. More than 1 Year

PLACE OF TREATMENT : 1. No / 2. HSC / 3. PHC / 4. GOVT. Hospital / 5. Pvt. Hospital / 6. ISM.

VITAL EVENTS FOR THE PERIOD FROM / / TO / / .

FORMNO

BIRTHS

SNO	DATE OF BIRTH: DATE	MONTH	YEAR	SEX	BO	PLACE	NATURE	BW	BD	BR
		/	/							
		/	/							
		/	/							
		/	/							
		/	/							

SEX: 1. Male / 2. Female

PLACE: 1. Domiciliary / 2. Government Institutions / 3. Private Nursing Homes

NATURE: 1. Normal / 2. Assisted / 3. Caesarian

BIRTH WEIGHT: 1. Less than 2.5 KG / 2. 2.5 KG AND MORE

BIRTH DEFECTS: 1. Yes / 2. No

BIRTH REGISTRATION: 1. Yes / 2. No

DEATHS

SNO	NAME OF THE DECEASED	CATEGORY	SEX	AGE	CASE OF DEATH	TREATMENT	DISEASE

SEX: 1. Male / 2. Female **AGE:** Completed year, If less than 1 Year then write "000"

CAUSE OF DEATH: 1. Old Age/Natural Cause / 2. Accident / 3. Disease / 4. Suicidal / 5. Murder

CATEGORY: 1. Infant / 2. Maternal / 3. Child / 4. Others

TREATMENT TAKEN: 1. Yes / 2. No

HEALTH STAFF WITH DESIGNAION
SIGNATURE WITH DATE

MONITORED BY
SIGNATURE WITH DATE
(SHN)

SUPERVISED BY (1)
(CHN)

SUPERVISED BY (2)
(DISTRICTS LEVEL STAFF)

1630600657

Annexure-IV
List of Investigations carrried out in the Medical Camps

S.No.	Name of the Investigation
1	Blood pressure
2	Hemoglobin
3	Blood Sugar
4	Blood Cholesterol
5	Blood Grouping including RH typing
6	VDRL
7	HIV
8	Blood smear for malaria
9	Urine Albumin Sugar
10	Sputum for AFB
11	ECG
12	Ultrasound Sonogram
13	Pap Smear (VIA),

Annexure-V
List of Equipments used for the Medical Camp

S.No.	Name of the Equipments
1	Ultra sonogram
2	ECG Machine
3	Ophthalmoscope
4	BP Apparatus
5	Thermometer
6	Tongue depressor
7	Stethoscope
8	Knee Hammers
9	Foetoscope
10	Vaginal Speculums
11	Pap Smear Kit / VIA Kit
12	IUD Kit
13	Proctoscope
14	Sterilizer
15	Cheatless forceps
16	Bins
17	Kidney Tray
18	Wash Basin
19	Soap dish
20	Vision Chart
21	Refraction set
22	Eye testing kit
23	Head lamp
24	Voltage Stabilizer
25	UPS
26	Extension Card
27	Semi Auto Analyzer
28	Binocular Microscope with oil immersion
29	Centrifuge
30	Micropipette
31	Sprit Lamp

Annexure-VI
List of Chemicals, Reagents and Kits used for the Survey

S.No.	Name of the Chemical / Reagent
1	Drapkins Solution
2	Blood Glucose Kit
3	Serum Cholesterol Kit
4	Blood Grouping Serum
5	JSP Strain
6	WIDAL Antigen Set
7	VDRL Test Kit
8	HIV Test Kit
9	AFB Straining Kit
10	AFB Straining Kit
11	Diastixs for Urine sugar and Albumin
12	Multistixs
13	VIA Kit

Annexure-VII
List of Small Scale Industries at SIPCOT Thuthukudi

S.No	Name of Unit	Plot No	Extent in Acre	Product
1	M/s. Aircel Ltd	No.1/PL	0.57	Cellular mobile communication system
2	M/s. Ammayappar Road Ways	C-99	2.45	Body building workshop for Lorries and Buses
3	M/s. Amulya Sea Foods	C-96,97,84&72A	4.57	Sea foods
4	M/s. Arasan Air Products(P) Ltd.,	C-60	1.40	Industrial Air
5	M/s.Archana Spinners	C-58	2.65	Setting up a Textile unit for doubling & winding of Yarn
6	M/s. Baby Aqua Foods	C-77/A2 & C- 77/B1/pl	1.90	Cold Storage
7	M/s. Balamurugan Enterprises	C-30	1.60	Plaster of Paris
8	M/s. Balamurugan Industries	C-31	1.34	Plaster of Paris
9	M/s. Britto Exports	C-1/PL	3.00	Cold Storage & White Ice
10	M/s. Classic Salt Industries	C-27	1.10	Iodised Salt
11	M/s. Coco Tufters Ltd	C-28,29,32&33	5.26	Doormats and floor covering from natural fibers.
12	M/s. Condor Access (P) Ltd	C34, 33/A	1.67	Scaffoldings manufacturing unit
13	M/s. Earth Mineral Resources	C-4	3.01	Processing of Illuminite
14	M/s. Genex	C-77(B)	0.57	Processing of Cuttle fish bone
15	M/s. Gnanam Ice Plant	C-56	1.17	Ice Plant
16	M/s. Handy Water Base India Ltd	C-3	1.21	Processing Crab Meat
17	M/s. Indian Oil Corporation	C-103 B	0.79	Petrol Bunk
18	M/s. Jainarain Santhose Kumar	C-2/A	1.50	Iodised Salt
19	M/s. Jeya Inds & Engineering	C-103A	0.85	Steel Metal Components
20	M/s. K.T.V.Oil Mills	C-70/71/85/86	3.89	Edible Oil
21	M/s. Kader Investment & Trading	C-51&52	2.75	Cold Storage
22	M/s. Kani Ice Plant	C-57B	0.97	Ice Plant
23	M/s. Kilburn	C-79,A-80&81	21.02	Titanium Ti-Oxide

	Chemicals Ltd			
24	M/s. M.M.Nagalingam Refineries	C-19/Pt	1.13	Edible Oil
25	M/s. M.V.Subramanian	C-101		HDPE Bags
26	M/s. Maheshwari Salt Trading Co	C-65&66	2.92	Iodised Salt
27	M/s.Mandadiar	4/pt	0.40	White Ice Block
28	M/s. Maris Associates	C-93&102	3.57	Paper bags
29	M/s. Maris Corporation	C-95&100	3.92	HDPE Bags
30	M/s. Marivel Edlback(P) Ltd	C-94	1.48	HDPE Bags
31	M/s. Max-Box	C-89/Pt	1.12	Corrugated Boxes & Board
32	M/s. N.C.John & Sons	C-6,7&8	8.13	Sisal/Floor Covering Jute & Coir mat
33	M/s. Narmatha Industries	C-32A	1.00	Coconut shell powder
34	M/s. Nepoli Furnitures(P)Ltd	C-1/Pt	0.89	Wood & Steel Furnitures Manufacturing
35a	M/s. Ninans Ltd	C-76-B, C-77(A)Pt	1.35	Sea Foods
35b	M/s. Ninans Ltd.,	C-80	1.87	Freezing for Ice Plant/Cold Storage
36	M/s. P.S.S.Ganesan & Sons	C-82&83	3.25	Senna Leaves
37	M/s. P.S.S.Krishnamoorthy Exports	C-188&19A	3.00	Senna Leaves
38	M/s.Parman Enterprises	C-59A	1.03	Aluminium Products
39	M/s. Pearl Silicon	C-59/Pt	1.22	Silicate
40	M/s. Philips Foods India Ltd	c-75/a,75/Pt&76	2.53	Pasteurized Crab Meat & Ice producing Plant & Cold Storage
41	M/s. Prasad Spinners	C-81	1.11	Yarn Doubling
42	M/s.R.V.Ice Plant	C-77	0.88	Ice Plant
43	M/s.Raj Salt Industries	C-63	1.01	Iodised Salt
44	M/s. Raj Trading Company	C-64	1.58	Iodised Salt
45	M/s. Raja Industries	A-75/Pt	1.34	Cement Concrete Blocks
46	M/s. Ramesh Flowers Pvt.ltd	A-62/Pt	4.95	Artificial Flowers
47	M/s. Reliance	C-73/&74	1.36	Data Communication Service

	Infocom Ltd			
48	M/s. S.E.C.Services	8	2.77	Container Freight Station
49	M/s. S.G.J.Auto Care(P) Ltd	C-21	2.17	Servicing Automobiles
50	M/s. S.K.S.Natarajan & Bros	C-41	2.24	Iodised Salt
51	M/s. S.V.S.Concrete Blocks	C-69	1.44	Cement Concrete Blocks
52	M/s. S.V.S.Natarajan & Sons	C-68&88	2.31	Spices Powder
53	M/s. Southern Fuels Ltd	A-82/Pt & 83	9.51	Low ash metallurgical cake from imported coal
54	M/s. Sri Kailash Chemicals	C-67	1.77	Iodised Salt
55	M/s. St.John Paper Boards	C-91	1.12	Container Freight Station
56	M/s. St.John Freight System(P) Ltd	C-98	3.02	Container Freight Station
57	M/s. Sun Reclimary	C-22/Pt	0.25	Reconditioning of water lubricating oil
58	M/s. Thim Poly Bags	C-78	2.01	HDPE Woven sacks
59	M/s. Thim Engineering	C-79	2.19	HDPE Woven sacks
60	M/s. Tuticorin Textiles	C-103	13.34	Yarn spinning
61	M/s. V.V.D.Crops & Chems	C-92	1.63	Activated carbon
62	M/s. Vasanth Polymers	C-57 B	0.97	Plastic Bags
63	M/s. Yentop Manickam Edible Oil	C-20/Pt	1.18	Refined Edible Oil
64	M/s. Yentop Manickavel & Sons Edible Oil	C-20/Pt	1.18	Refined Edible Oil
65	M/s. Universal Pavers	A-83	7.03	Concrete Blocks
66	M/s. M.G.M.Edible Oil(P)Ltd	C-22&39	1.57	Edible Oil Processing

Annexure-VIII
Medium & Large Scale Industries in Thoothukudi Region

S.No	Industry	Product
1	Southern Petrochemical Industries Corporation Limited Spic Nagar, Thoothukkudi	Urea & Di-Ammonium Phosphate, Aluminium Fluoride, Sulfuric Acid, Ammonium Chloride.
2	Travancore Chemicals and Manufacturing Co. Ltd. Mullakaddu.	Sulphate of Alumina & Sodium Sulphide
3	Thoothukkudi Alkali Chemicals and Fertilisers Ltd., Harbour Construction Road, Thoothukkudi	Soda Ash, Ammonium Chloride
4	Thoothukkudi Spinning Mills Ltd. Palayam Kottai Rd. Thoothukkudi	Cotton Yarn
5	South India Carbonic Gas Industries. Harbour Constructin Road. Thoothukkudi.	Carbon di-oxide
6	Madura coats Ltd. Beach Road, Thoothukkudi	Cotton Yarn & Thread
7	Arasan Textile Mills (P) Ltd. South Cotton Road, Thoothukkudi	Cotton Yarn
8	Dharangadhara Chemical Works	Caustic Soda, Hydrochloric Acid, Liquid Chlorine
9	Kilburn Chemicals Ltd., Sipcot Complex, Thoothukkudi	Titanium – Dioxide
10	Tuticorin Thermal Power Station, Thoothukudi	Electric Power, Coal Ash
11	Bharat Petroleum Corporation Ltd., Thoothukudi.	LPG Bottling Unit
12	Port Trust, thuthukudi	Handling of bulk cargo including coal, fertilizer etc.,