Industrial Growth And Environmental Degradation:

A Case Study Of Tiruppur Textile Cluster

Prakash Nelliyat

Research Associate
Madras School of Economics
Gandhi Mandapam Road
Chennai – 600 025, India
Tel: +91-44-2235 2157, 22300304 / 7
Fax: 91-44-2235 2155, 22354847
E.mail: nelliyatp@yahoo.co.uk

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MADRAS SCHOOL OF ECONOMICS
Gandhi Mandapam Road
Chennai 600 025
India

Phone: 2230 0304/ 2230 0307/2235 2157
Fax : 2235 4847 /2235 2155
Email : info@mse.ac.in
Website: www.mse.ac.in

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Abstract

The rapid economic growth achieved after globalization by most of the developing countries, has imposed considerable social costs and has become a major threat to sustainable development. However it is also extremely important for developing countries to achieve a high level of economic growth to mitigate their socio-economic problems. But the major challenge here is to ensure development in a sustainable manner by achieving a proper trade-off between environment and development. This paper attempts to operationalize sustainable development strategies using a case study of Tiruppur, a major textile cluster in India. The textile industrial growth in Tiruppur is discussed in the context of global diversification of textile manufacturing and trade with emphasis on employment, income and foreign exchange in regional economy perspective. Since the environmental issues of textile industries are associated with bleaching and dyeing, an inventory of all processing units was prepared for analysis include water consumption and effluent discharge. The existing pollution management efforts through IETPs and CETPs and economics of production and pollution control costs were estimated for different size of units for understanding the burden of pollution abatement. Environmental impacts of pollution were analyzed with the help of physical data on ground water, surface water and soil quality. The economic value of the damage (social cost) was estimated for different sectors like agriculture, fisheries, domestic and industrial water supply. Different economic and environmental indicators of Tiruppur industry over the period 1980-2000 and the reasons for the environmentally unsustainable industrial growth of Tiruppur are provided. The paper concludes with some policy recommendations and recent development in Tiruppur.

Acknowledgement

The paper has been prepared based on my Ph.D dissertation entitled "Industrial Growth and Environmental Degradation: A Case Study of Industrial Pollution in Tiruppur" which I submitted to the University of Madras. I pursued my research work under the supervision of Prof. Paul P Appasamy, Member Secretary, Centre of Excellence in Environmental Economics, Madras School of Economics. I am grateful to Prof. Paul P Appasamy, for his encouragement and suggestions in completing this paper.

Introduction

The rapid economic growth achieved by most of the developing countries after globalization has adversely affected the quality of the environment, imposed considerable social costs and livelihood impacts, and has become a major threat to sustainable development[1]. Since the citizens of poor countries may not demand a high level of environmental quality, these countries take up export oriented manufacturing which is sometimes pollution intensive. It is extremely important for developing countries to achieve a critical level of economic growth to mitigate their unemployment and poverty. But the major challenge is to ensure development in an environmentally sustainable manner, so far to achieve a proper trade-off between environment and development. Normally developing countries may have reasonably good growth policies and strategies for agriculture, industry and infrastructure development, but not have a sound environmental management policy.

The global diversification and shift of textile manufacturing and exports to developing countries has had significant implications for the Indian textile sector. The textile industrial growth and export in India has been appreciable during the last two decades. Since most of the textile centres have developed as small-scale clusters, pollution management and enforcement is not at a satisfactory level. Hence in many places the pollution load discharged into the environment has exceeded the assimilative capacity and caused severe degradation of the quality of the environment, and ultimately affected different sectors like agriculture, domestic water supply, fisheries, public health and biodiversity. Even though these types of tradeoffs between development and environment are common in many countries, most of the research has emphasized either the development aspect or the environmental aspect, but not from a sustainable development perspective. The doctoral thesis is an attempt towards the operationalization of sustainable development strategies through a case study of Tiruppur, a major textile cluster in Tamil Nadu. The thesis includes the following aspects:

(a) Industrial growth and socio-economic contribution of the textile industry to the regional economy of tiruppur,

(b) Pollution abatement cost of the textile wet processing units which cause pollution,

(c) Environmental damage caused by textile effluents to different sectors in the Noyyal river basin, and

(d) Appropriate policy options for achieving sustainable industrial development of Tiruppur through various institutional and technological options.

Impact of Diversification of the Global Textile Industry

During the last few decades, substantial global shifts have occurred in textile production and export. Before 1980, countries like Germany, Italy, France, UK, The Netherlands, and USA played a vital role in world textile and clothing exports. But by 1995, the dominance of these countries had substantially reduced and the share of developing nations, especially the Asian countries like China, Korea, Taiwan, India, Pakistan and Thailand had increased (Dicken, 1998). The main factor attributed to this shift is the cheap labour costs in developing nations compared to the western countries (Vijayabaskar, 2001). The environmental policies, which are relatively less stringent in developing nations might also have contributed to the shift in the location of textile manufacturing.

During the post liberalization period of the Indian economy, the cotton textile and garment industries grew rapidly due to the availability of cheap labour and raw materials. The country has more than 9 million hectares of area under cotton cultivation and annual production of around 3 million tones of cotton (Compendium of Textile Statistics, 1999). These industries generate substantial employment, income, and foreign exchange. The percentage of textiles in the total exports from India doubled from 17 per cent (1981-82) to 31.6 per cent (1998-1999). At present the textile industry accounts for about 14 per cent of the national industrial production and about 4 per cent of GDP. It provides employment opportunities to 35 million people, particularly in the rural and remote areas of the country. Around 10 per cent of the excise revenue is obtained from the textile sector (Compendium of Textile Statistics, 1999; Ministry of Textiles, 1999). The Indian textile sector has been experiencing structural transformation through the reduction in the role of the organized mill sector and an increase of the small scale and cottage sectors (handlooms, power loom, knitwear and garment making units). These sectors are developing in a highly decentralized and flexible industrial networking manner as clusters. To some extent, the industrial policy adopted by the Government of India which emphasized the growth of small-scale industries (SSIs)[2] has also favoured the growth of textile industries as clusters. Institutions like the South India Textile Research Associations (SITRA), Apparel Export Promotion Council (AEPC) and Textile Committee (TC) have promoted the growth and development of the textile industry.

However, the wet processing (bleaching and dyeing) segment of the textile industry has caused severe environmental damage. The textile processing units use huge quantities of water and different chemicals. The effluents discharged by the units are generally hot, alkaline, strong smelling and coloured. Some of the chemicals which are discharged are toxic too. Unfortunately, the majority of the textile units especially the smaller ones are not treating their effluents properly and the untreated or partially treated effluents are discharged into water bodies or on land and sometimes the effluent is used for irrigation (Mukherjee and Nelliyat, 2006). In many clusters around the country, textile effluents have caused serious environmental impacts at the regional level. The technological development in the wet processing segment of the textile industry is not at a satisfactory level. Most of the small units are using traditional processing technology, which are not environment friendly. Cleaner Production technology like soft flow machines has a lot of scope in textile processing.

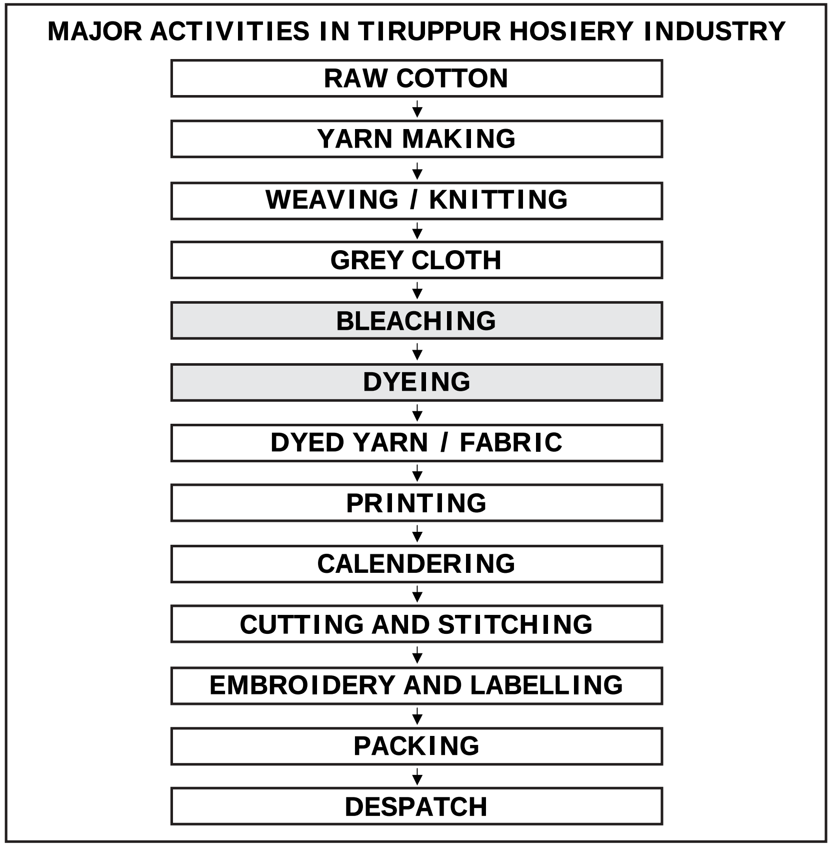
Textile consumers in Europe and US have become more concerned about environmentally sound products with eco-labels. Consequently, the market for products produced in a environmentally friendly way is growing. After realizing the seriousness of the above issue, the Government of India and the textile industry took certain measures to meet the eco-labeling requirements. For eco-specification, twelve eco-testing laboratories were set up in various textile centres. Generally, the eco-mark schemes specified that "the products should be manufactured in an environmentally friendly way". It means the product or its manufacturing activities should not create any environmental consequences for both the consumers of the product as well as the public through waste disposal. Unfortunately, in the Indian textile industry eco-labeling criteria are applied only to the product quality and not to the manufacturing related pollution or process aspects.

Growth of the Textile Industry in Tiruppur

Tiruppur is a major knitwear centre in India with more than 9000 small-scale units. Industrial growth started in Tiruppur in 1930. The electrification of the town during the late 1930's, the removal of the ban on import of new machines in 1952, the shifts from farm to factories during 1960s, the industrial unrest which existed in West Bengal in 1968, the growth of ancillary units during 1970s, and the encouragement provided by government towards export in the early 1980s, are important landmarks in the history of the growth of the hosiery industry in Tiruppur (Swaminathan and Jeyaranjan, 1995; Vijayabaskar, 2001). The transformation of Tiruppur from a village agrarian economy to the 'knitwear capital of India' occurred within a very short period of three to four decades. The hot climate and good quality of water, easy availability of raw material (cotton), skilled labour, good infrastructure facilities, industrial networking, institutional support, and export culture, are some of the reasons for the rapid industrial growth of Tiruppur (Nelliyat, 1995; Nelliyat, 2005). The city contributes 56 per cent of the total cotton knitwear export from India.

Yarn making, weaving/knitting (cloth making) are the major activities at the first stage in the hosiery industry. The second stage is primarily the textile processing in which the bleaching and dyeing of grey cloth and printing are the major steps. Besides, a number of other ancillary activities like calendering, and rinsing are also being undertaken on a need basis. The third stage is the garment manufacturing which includes the activities of cutting, stitching, embroidery, buttoning, labelling, packing and dispatching/exporting (Figure 1). A few entrepreneurs who are mainly the direct exporters have all the above-mentioned activities in their own factory premises. They feel that vertical integration is an advantage in the export business, in order to guarantee quality and timely delivery.

Figure - 1



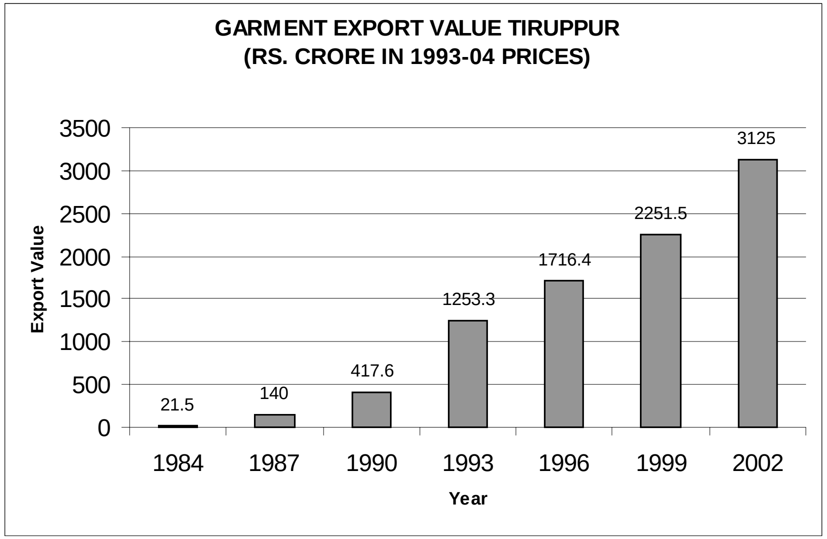
Source: Nelliyat, P (2005)

Unlike other clusters, Tiruppur has demonstrated the ability to move up the value chain, albeit in a limited manner. Its product range has diversified, with a marginal increase in unit value addition.

Contribution to the Regional Economy

The socio-economic contribution of the industry is substantial. Different varieties of hosiery products, which have good domestic and international markets are manufactured in Tiruppur. Figure 2 provides the growth in export value of garments from Tiruppur in constent prices. The export earnings from Tiruppur during the year 2005-06 was about Rs. 10,250 crore based on current prices.

Figure 2



Source: Nelliyat, 2005.

The textile industry provides employment for more than 2,00,000 people (majority of them are local). The total investment made by the hosiery industrial sector in Tiruppur is Rs. 858 crore and the annual value generation at single shift base in 2002 was Rs. 1910 crore. The rapid technology transformation, flexible organizational structure and industrial networking are unique aspects of industrialization in Tiruppur (Swaminathan and Jeyaranjan, 1995). Each segment of the industry has its own association which has played an important role in the industrial development of Tiruppur. Among these the role of Tiruppur Exporters Association (TEA) is significant. SITRA, AEPC and TC have their offices in Tiruppur for providing direct services to hosiery manufacturers and exporters.

The Indian textile industry faced a challenge with the WTO Agreement on Textile and Clothing and the dismantling of the quota regime. From 1st January 2005 onwards all textile and clothing products would be treated equally without quota restrictions. The dismantling of the quota regime represents both an opportunity as well as a threat. An opportunity because the market will no longer be restricted: a threat because markets will no longer be guaranteed by quotas. Tiruppur industry has a great ability to face any challenge and it is well prepared for the new WTO Agreement on Textiles and Clothing. For continuing the business performance from Tiruppur during the post 2005 era, the Tiruppur Exporters Association has charted their goal and chalked out a number of initiatives. The role of the hosiery industry in the regional economy of Tiruppur is substantial and most people in this region in one way or other depend on this industry for their livelihood.

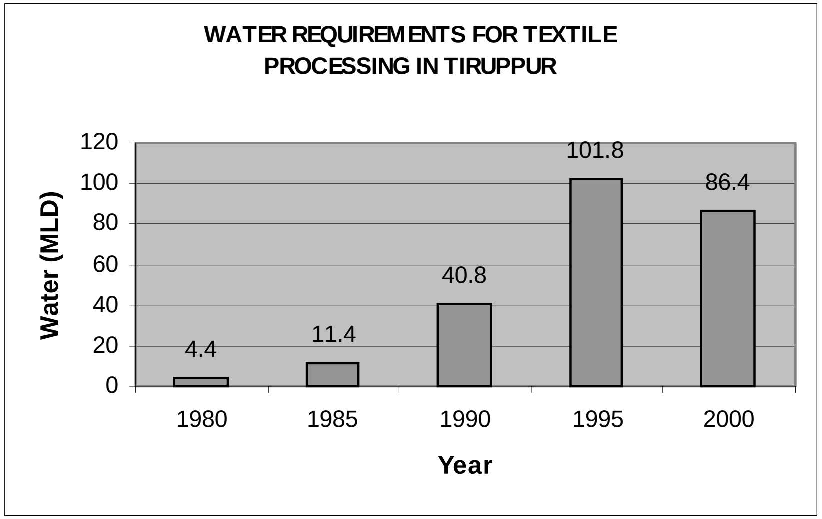
Wet Processing and Water Demand in Tiruppur

Wet processing (bleaching and dyeing) is a sub-sector of the hosiery industry. After the export boom started in the 1980s, the number of wet processing units rapidly increased in the Tiruppur cluster. In 1981, there were only 26 bleaching and dyeing units in Tiruppur. But the number had increased to 324 in 1991 and 702 in 2001. The majority of the units are small in size and function as job workers for the hosiery

industry. Out of the 702 wet processing units, 125 are located in Tiruppur municipality and the remaining 577 are spread out in the peripheral villages. Most of the units are located on both sides of the Noyyal river which is convenient to discharge the effluent. Low investment, bright future of colouring in clothing industry, good profit margins and prior experience in textile processing, are some of the factors which encouraged the entrepreneurs to select textile processing from other segments of the hosiery industry. The quantity of cloth processed by these units is around 15,000 tonnes per month. For processing, various chemicals such as soda ash, dyes and bleaching agents are used and their consumption rate has increased over time in proportion to the quantum of cloth processed. Much of the chemicals and acids used for processing are not retained in the cloth but discharged as waste material, which ultimately leads to high pollution load in the effluents.

For textile processing, water is an unavoidable input factor. Corresponding to the growth in the volume of cloth processed, the quantity of water consumed by the processing units has also increased over time from 4.4 million litres per day (mld) in 1980 to 40.8 mld in 1990 and to 86 mld in 2000 (Figure 3). Earlier industries extracted their required water from the Noyyal river or their own wells. But from early 1990s onwards due to water quality degradation in Tiruppur, substantial quantity of fresh water (91 per cent of the total demand) is transported from peripheral villages through tankers. The continuous functioning of the 'water market' has adversely affected the ground water availability of the villages and in many places ground water tables have declined. Recently, industries are also getting water through the Tiruppur Area Development Project's water supply scheme[3] to transport water from the Cauvery river (Nelliyat, 2007).

Figure 3



Source: Nelliyat (2005)

The water requirement per kilogram of cloth processed has shown a declining trend from 226.5 litres per kg in 1980 to 144.8 litres per kg in 2000. Low availability of good quality water in the Tiruppur area, increase in the cost of water transportation, and the technology improvements in processing are some of the reasons attributed to the reduction in water usage per kilogram of cloth processed. The average water requirement for dyeing one kilogram of cloth is 175 litres in small and medium level units, but only 120 litres per kg in larger units. Processing technology is the major determinant factor in water requirement. Generally, smaller units exclusively depend on winches, while larger units depend on soft machines, which use less water for processing.

Environmental Management and Costs of Pollution Abatement

The processing units in Tiruppur generate/discharge around 83 mld of effluents. The effluents carry considerable volume of chemicals used in different processing stages in the units. Due to the continuous discharge of effluents for over a decade, the magnitude of pollution has increased in the Tiruppur area resulting in environmental degradation. In 1991, the Tiruppur Dyers' Association formed a company, the Tiruppur Effluent Treatment Company (P) Ltd and initiated certain attempts towards the construction of effluent treatment plants. Unfortunately, progress towards the effluent treatment programme was negligible till 1996. Subsequently in 1997, following the Order of the High Court industries which did not have effluent treatment facilities had to close and the remaining units decided to construct effluent treatment plants. At present, the units are treating their effluents either through Individual Effluent Treatment Plants (IETPs) or Common Effluent Treatment Plants (CETPs). Of the 702 units, 278 units are treating their effluents through eight CETPs while 424 units have individual effluent treatment plants. Due to scale economies, CETPs should be preferable to smaller units. But, size has not been the major factor in the choice of common versus individual effluent treatment plants.

The majority of the units who prefer IETPs were not familiar with the advantages of CETPs at the time of their decision. But some of the units who were familiar with the merits of CETPs preferred IETPs, mainly because the CETPs were located far away from their premises and due to less faith in collective action. On the other hand, some of the units which preferred CETPs were well aware of the economies of CETPs including the subsidy factor. Besides, they felt that if they provided the initial equity and monthly subscription to CETP they would be free from their responsibility regarding effluent treatment. A few units functioning on leased land or in congested areas were compelled to join CETPs since they did not have their own land for constructing individual treatment plants. Ideally CETPs are preferable in a small scale industrial clusters like Tiruppur for many reasons including economies of scale in treatment, easy monitoring and enforcement, and better scope for implementing advanced treatment methods like Reverse Osmosis (RO)[4]. Unfortunately, in Tiruppur out of 702 textile processing units only 278 units joined the eight CETPs.

For effluent treatment, Rs. 47.68 crore (Rs. 27.24 crore by CETPs and Rs. 20.44 by IETPs) was spent as fixed costs. In the case of CETPs the fixed cost was highly subsidized by the government. Besides, Rs. 31.18 crore (Rs. 11.84 crore by CETPs and Rs. 19.34 by IETPs) is incurred as annual variable or running costs (Table 1). The variable cost of pollution abatement is much higher than the annualized capital cost both in the case of IETPs (86 per cent) and CETPs (73 per cent).

Table 1

EFFLUENT TREATMENT COST FOR IETPs AND CETPs IN TIRUPPUR

Mode of Treatment	Annual Effluent (K/L)	Annual Cloth Processed (Kg)	Total Capital Cost (Rs. Lakh)	Annual (Rs. Lakh)			Cost per Kg of Cloth Processed (Rs.)		
				Capital Cost	Variable Cost	Total Cost	Fixed Cost	Variable Cost	Total Cost
IETPs (424)	14089920	111209280	2043.95	326.42	1934.4	2260.82	0.29	1.73	2.02
CETPs (278)	11849448	75054720	2724.00	435.05	1184.9	1619.95	0.58	1.58	2.16
Total (702)	**25939368**	**186264000**	**4767.95**	**761.47**	**3119.3**	**3880.77**	-	-	-

Note: The numbers in the brackets are number of units

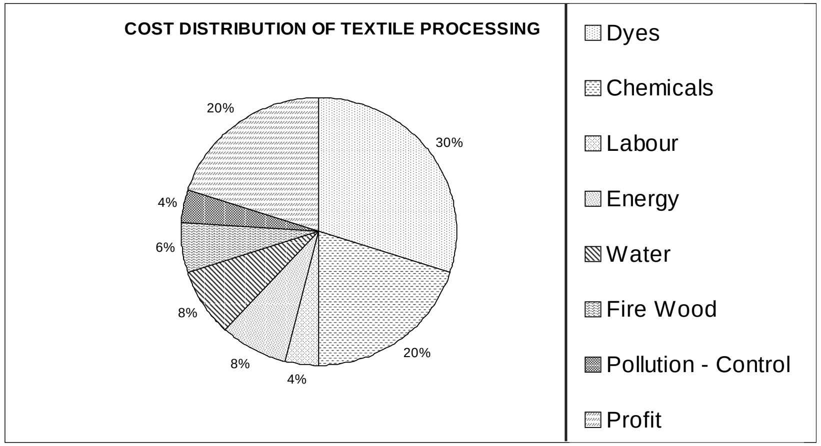
Source: Nelliyat, 2005 (Estimated based on TNPCB data).

Unfortunately the present effluent treatment system is insufficient for reducing the total dissolved solids (TDS), particularly the chlorides and sulphates. The average TDS concentration in the treated effluents is as high as 6394 mg/l in IETPs and 6537 mg/l in CETPs, which is far higher than the standard of 2100 mg/l. The same is true of chloride, which averages 3290 mg/l in IETPs and 3127 mg/l in CETPs whereas the standard is 1000 mg/l. Since there is no subsidy for operation or maintenance cost, many industries are not willing to operate their effluent treatment plants. Besides, the Tamilnadu Pollution Control Board (TNPCB) did not take any serious action against the industry when they violated the standard (effluent norms). Normally, the further expansion and efficiency improvement in the treatment system is difficult for small units. Since the TDS discharge is unabated, the impact associated with it is substantial.

Primary Survey

The value addition of textile processing and the ratio of pollution abatement was obtained through a detailed survey of 15 units of different size classes. The value addition of textile processing varies a great deal depending on the quality and purpose. Bleaching value addition varies from Rs. 9 to Rs. 50 per kg. (average of Rs. 24). The survey showed that the value addition per kg is positively related with the size of the unit, since generally the bigger units are doing the quality processing. Value addition in processing also depends on the client/target group. Normally the value addition for the cloth used for export is double that of the cloth processed for the domestic market. The total cost of textile processing is distributed as 30 per cent for dyes, 20 per cent for chemicals, 4 per cent for labour, 8 per cent for energy, 8 per cent for water, 6 per cent for firewood, 4 per cent for pollution abatement and 20 per cent profit margin (Figure 4). Thus, the average share of pollution abatement cost in the total cost of textile processing is at present only 4 per cent.

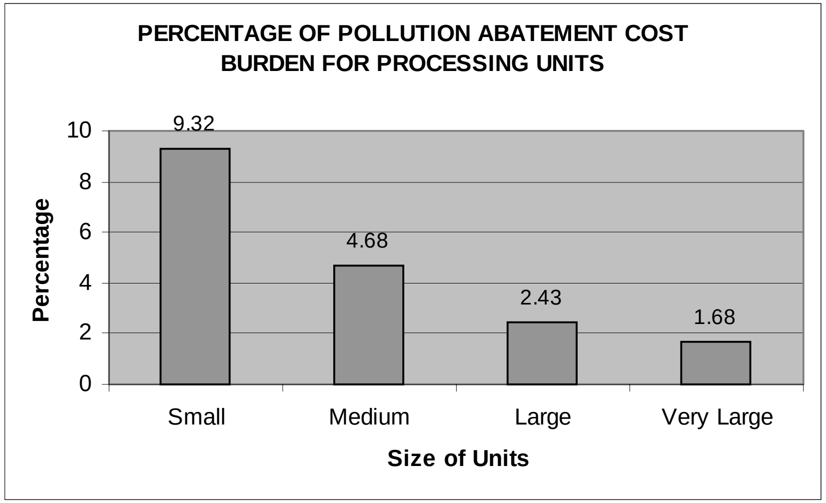
Figure 4



Source: Nelliyat, 2005 (Estimated based on Primary Survey)

The pollution abatement cost for 1 kg of cloth processed varies from Rs 0.92 to Rs. 3.50. Generally the cost does not vary due to the treatment options (IETP/CETP). For units, the pollution abatement cost is a newly emerging cost of production and is met either by increasing the price or by sacrificing the profit margin or through a combination of both. Since the processing units are large in number, the competition is very high. Hence industrialists have a general reluctance to allocate the pollution abatement cost to production cost, since any increase in the price may affect their business. The percentage of pollution abatement cost in the processing value addition varies between one per cent and 14.30 per cent. The burden of pollution abatement is unequally distributed among the units. The pollution abatement burden is very high for small units (9.32 per cent) compared to the medium scale units (4.68 per cent), large scale units (2.43 per cent) and the very large units (1.68 per cent) {Figure 5}. Hence any additional investment for pollution abatement is extremely difficult for the small units.

Figure 5



Source: Nelliyat, 2005 (Estimated based on Primary Survey)

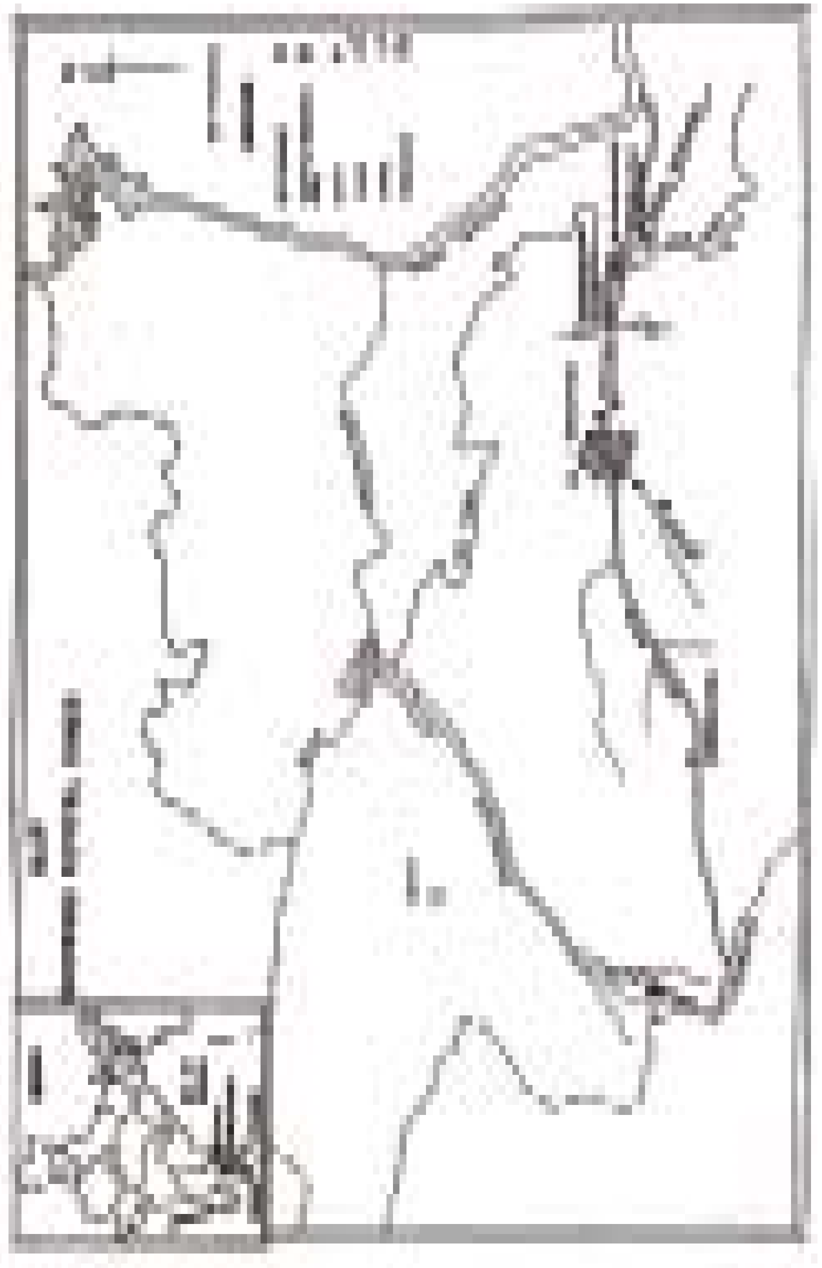
For the integrated units (who have all hosiery related activities including textile processing), whatever the pollution abatement cost they are incurring is only a small part of their overall expenditure for the business of garment manufacturing. Generally most of the integrated units are direct exporters and to some extent they are successfully doing pollution management through the introduction of eco-friendly technologies and dye bath segregation. These units are also planning to install Reverse Osmosis plants and achieve zero discharge in the near future. In integrated units, the pollution abatement cost is 1.6 per cent of the garment/T Shirt manufacturing cost, and only 1 per cent of market price of the garment.

Environmental Impact and Damage Cost of Pollution

The environmental problems in Tiruppur area are due to the accumulation of effluents in the soil and water. From 1980 to 2002, the cumulative pollution load discharged by the Tiruppur units, is estimated to be 2.87 million tonne of total dissolved solids (TDS) like chloride and sulphate. Around 80 per cent of the pollution load has accumulated in the Tiruppur area. Rainfall (annual average of 617 mm) has only a marginal effect in reducing the severity of the impact (Map).

Available studies (water and soil quality) clearly prove the accumulation effect of pollution in Tiruppur area and down stream of the Noyyal basin. A number of ground water studies have been carried out by academic institutions and government agencies in recent years[5]. The major conclusions of these studies are as follows:

- Open wells and bore wells in and around Tiruppur and the downstream stretch of Noyyal exhibit high levels of TDS (most areas > 3000 mg/l and some places even up to 11,000 mg/l) and chloride (generally > 2000 mg/l and certain areas upto 5000 mg/l) due to industrial pollution.
- The current values of pollution concentration are very much higher than the background levels for this region.
- Rainfall has only a marginal influence in reducing the concentration of TDS.
- High possibility in increase in pollution concentration in ground water in the near future if effluent discharge by textile processing units continues.



- High concentration of heavy metals in ground water including zinc, chromium, copper, and cadmium.
- The open and bore wells located around 4 kms radius of an irrigation reservoir at Orathapalayam are highly polluted with high TDS level and concentration of various salts.
- The establishment of effluent treatment plants in Tiruppur has not had any positive impact on the ground water quality.
- The studies also show that the available ground water is not suitable for domestic, industrial or irrigation use.

The surface water studies done by Government Departments and researchers indicate the following[6]:

- The pollution (EC/TDS) concentration in Noyyal river is low till the river reaches Tiruppur. But it increases considerably in the Tiruppur area, due to textile effluent discharge, and continues up to the Orathapalayam dam. But after Orathapalayam there is some improvement in river water quality.
- Pollution concentration in the river is greater in summer than winter.
- The existing moderate flow in the Noyyal river is not sufficient for diluting the pollutants.
- The Orathapalayam reservoir and system tanks have been badly affected by industrial pollution.
- High alkalinity, chloride, electrical conductivity, iron, phosphate and BOD in the water at the Orathapalayam reservoir.

- River and reservoir are not fit for aquatic organisms including fish.
- Concentration of high TDS and chloride at the tail end of the Noyyal at the confluence point with the Cauvery.
- Except for the rainy season when there is some dilution, the surface water is unfit for irrigation.

The soil quality study[7] also indicated the magnitude of pollution. The surface and sub-surface soil samples analysed based on pH show that the majority of the samples are alkaline (pH > 8.5) or tending to alkaline (pH 8 - 8.5).

The pollution impact is experienced by different sectors (agriculture, fisheries, domestic and industrial water supply, human health, and bio-diversity) in the Tiruppur area and downstream of the Noyyal River. In agriculture, since the ground water and surface water sources (irrigation tanks and reservoirs) are not fit for cultivation, farmers incur heavy losses. The surface water is injurious to agriculture (EC > 3 mmhos/cm), in an area of 146.3 km^2 and critical (EC 1.1 to 3 mmhos/cm) in 218.3 km^2 (SS&LUO, 2002; Nelliyat, 2003). The saline sensitive crops like paddy and banana have completely disappeared from the pollution affected villages. Besides, the productivity of certain crops has declined considerably. The estimated overall annual damage cost in the agriculture sector was Rs. 35.29 crore and the capitalized value at 12 per cent is estimated to be Rs. 234.54 crore (MSE, 2002). In 1996 a downstream farmers' organization filed a court case against the Tiruppur industry.

The fisheries activities in the Noyyal river, system tanks and reservoir have been affected. The recent fish mortality at Orthapalayam reservoir compelled the Fisheries Department to stop the fish culture. The annual loss of value (Productivity Loss) in the fishery sector was Rs. 0.15 crore and the capitalized value at 12 per cent is approximately Rs. 1.25 crore (MSE, 2002). Besides, the possibilities of toxicity effect in the available fish are also high and their consumption may lead to serious health problems.

Due to the drinking water scarcity in Tiruppur town, the Municipality is bringing 32 mld of water from the neighbouring (Bhavani) basin for drinking water supply. In the affected villages, the Tamilnadu Water Supply and Drainage Board has introduced special water supply schemes. Besides, villagers fetch freshwater from distant places (unaffected wells). The total damage cost in the drinking water sector was estimated to be about Rs. 15.05 crore per annum and the capitalized value at 12 per cent is Rs. 109.03 crore (MSE, 2002).

The industries in Tiruppur themselves are affected by pollution. Since the industrial wells have only 'coloured water' they are transporting the major share of their water requirement (90 per cent), through tankers from peripheral villages located 25 - 30 km away from Tiruppur. The overall cost incurred by the industry for purchasing water is Rs. 89.10 crore per annum. Besides, the continuous functioning of the 'water market' has led to the depletion of water in villages, which has affected the livelihood of the rural poor. The estimated value foregone by agriculture is Rs. 11.7 lakhs (Palanisamy, 1995).

In summary, the total social costs of pollution in agriculture, domestic and fisheries sectors were estimated to be Rs.48.41 crore per annum (Table 2). Human health, bio-diversity (aquatic eco-systems of river, tanks and reservoir) and livestock are the other major sectors seriously affected by textile pollution. The available studies by scientists reveal the potential magnitude of physical impact of pollution in these sectors. The estimation of damage cost in these sectors was not attempted due to data and resource constraints.

Table 2

TOTAL DAMAGE COST OF POLLUTION (In Rs. Crore)

S.No.	Sectors	Annual	Capitalized
1	Agriculture	**35.29**	**234.54**
2	Domestic Water Supply	**13.05**	**109.03**
	(a) Urban (Tiruppur Municipality)	11.90	99.15
	(b) Rural (Water Supply Scheme)	0.21	2.14
	(c) Rural Households	0.94	7.74
3	Fisheries	**0.15**	**1.25**
4	Industrial Water Supply	**89.10**	**742.50**
	Total	**137.59**	**1087.32**

Source: MSE Study (2002), Nelliyat, 2003 and Nelliyat (2005).

Economic and Environmental Indicators

The study clearly reveals that the industrial growth, especially during the last two decades, in Tiruppur imposes high social cost at regional level, and hence may be unsustainable. The positive contribution of the industry (economic indicators) and negative implications of industrial growth on the environment (environmental indicators) are compared for 1980 and 2000 (Table 3).

Table 3

ECONOMIC AND ENVIRONMENTAL INDICATORS OF TIRUPPUR INDUSTRY

Economic Indicators			***Environmental Indicators***		
Indicators	**1980**	**2000**	**Indicators**	**1980**	**2000**
No. of hosiery Units	1143	9319	Water Consumption	4.4 mld	86.4 mld
No. of Processing Units	26	702	Effluent Discharge	4.2 mld	83.1 mld
Qty. of Cloth Processed	19 t/d	597 t/d	Salt Consumption	127 t/m	6424 t/d
Investment (1993-94 price)	Rs. 21 Cr.	Rs.67 Cr	Pollution (TDS) Load	10300 t/y	107400 t/d
Value (1993-94 Price)	Rs 250 Cr.	Rs 1491Cr	TDS in Ground Water	2238 mg/l	6435 mg/l
No. of Pieces Exported	1.72 Cr.	49.66 Cr	Chloride in Ground Water	1151 mg/l	2743 mg/l
Export Value (1993-94 Price)	Rs 20 Cr.	Rs 3125 Cr	Sulphate in Ground Water	118 mg/l	438 mg/l
Employment (Registered)	10606	104958	Soil Quality (pH)	7.3	9.1

Source: Nelliyat (2005)

The pollution load discharged in these periods is more than the assimilative capacity of the environment. Hence considerable amount of pollution accumulation (mainly deterioration in the quality of ground water and soil) has occurred in the Tiruppur area. On the basis of the economic and environmental indicators one can conclude that the industrial growth in Tiruppur may not be environmentally sustainable. Under normal conditions, the industry benefits entrepreneurs, exporters, overseas importers and consumers, government, and labourers in

different geographical areas. But the social costs of pollution, in the form of natural resource degradation, affect a large number of people living in and around Tiruppur. Even though, the trickle down effects of SSIs like hosiery are substantial one cannot ignore the environmental issues associated with industrial growth.

Why is Industrial Development in Tiruppur Unsustainable?

It is very clear that the export boom in Tiruppur has led to serious damage to the environment. To some extent the over-all economic benefit of the industry has undervalued the environmental costs. However, the environmental cost, borne by the downstream communities who have no connection with the industries is a major concern. Moreover the physical environment (ground water, soil, river, ponds, and bio-diversity) of the entire region may be losing its ecological value in an irreversible manner. There are a number of reasons for the unsustainable development of Tiruppur, which can broadly be classified as market failure, policy failure and institutional failure.

Market Failure: The processing units are in the small-scale sector and hence the affordability of pollution control is a problem. In a competitive market situation entrepreneurs have problems in transferring the burden of pollution abatement to the consumers. The possibility for integrating the pollution abatement cost in the overall garment production in a decentralized cluster like Tiruppur is small. At present the dyers have the full responsibility of environmental management in Tiruppur but they are relatively small players in comparison to the garment manufacturers or the exporters. Thus, it has not been possible to internalize the external cost of pollution - a classic case of market failure.

Market failure at the international level has also failed to provide a "premium" for eco-friendly production which would have been an incentive to the industry. The concept of 'green production/business' has not influenced the Tiruppur industry. Eco-labeling considers only the product quality and not about the environmental aspects related to manufacturing. The overseas importers and consumers are aware about the environmental problems related to hosiery production, but their primary consideration is the market price. Presently they are not willing to pay more for the products, which are manufactured in an eco-friendly manner with proper pollution management.

Policy Failure: The liberalization policy and the subsequent expansion in international trade did not take into account the potential impact on the environment. It was anticipated that trade liberalization would provide significant gains to developing countries. Since most of the developing countries do not have sound environmental policies, trade liberalization often results in natural resource degradation and pollution problems. Many of the industrial units which achieved substantial progress after trade liberalization are in the cottage and small scale sectors.

This has take place also as part of national industrial policies, which provide reservation of industries, like hosiery under SSIs. Since SSIs do not have clean technologies as well as modern pollution management, they are facing serious difficulties in complying with domestic environmental regulations. In the Tiruppur case, exports which

enhanced the economic activities have also increased pollution. Industrial policies do not taken into account environmental repercussions. In Tiruppur, textile industrial growth is the key factor responsible for water pollution. But industrial policies rarely consider the pollution/environmental aspects.

The policy decision of the Pollution Control Board (PCB) to permit the units to put up their own individual effluent treatment plants has added to the workload of the Board. In a small scale cluster all/ majority of the units should have joined with CETPs. But in Tiruppur out of 702 units only 278 units are with CETPs. The PCB established a separate District Environmental Engineer's office at Tiruppur in 1996. Besides, a District Environmental Laboratory was also established. Even, with the existing staff and infrastructure facilities it is extremely difficult for them to monitor the 702 processing units in an effective manner.

Institutional Failure: The environmental management history of Tiruppur reveals the difficulties faced by the different institutions/actors like the State Pollution Control Board, Industrial Organizations, NGOs, Local Government, and the Water Resources Organizations, in finding a solution for the problem. Otherwise the environmental impacts may not have reached this level. At present with the existing effluent treatment facilities are not meeting the TDS standard. Tiruppur Exporters' Association (TEA), South India Textile Research Association (SITRA), Apparel Export Promotion Council (AEPC), Textile Committee (TC) South India Hosiery Manufacture Association (SIHMA), and the Tiruppur Dyers Association (TDA) are the major facilitators for hosiery industrial development in Tiruppur. The TDA is doing the best in terms of pollution management. Unfortunately, so far no serious attempt has come from the powerful organizations like TEA. They feel that pollution management is essentially the dyers' problem and exporters do not have any direct responsibility. The processing units depend on the services of SITRA and TC for quality checking. But SITRA has not done much collaborative work with Tiruppur industry in regard to pollution management. Their full concentration has been on garment quality improvement.

The efforts from government departments to deal with the impact of pollution has also not taken place in the case of Tiruppur. The Departments of Agriculture, Public Works, Fisheries and Water Supply which are the major state agencies affected by textile pollution have not registered their protest. Another disappointing aspect is the weak efforts of local NGOs and households. Generally local people who depend on the industry are short sighted and feel that any agitation against pollution might be a threat to industry. Since industrial activities are the source of income and livelihood for most of the residents of Tiruppur raising any negative views like pollution may be counter productive. A collaborative pollution management effort from industrial organizations or promotion agencies, the line department and local NGOs is very much lacking in Tiruppur.

The role of the New Tiruppur Area Development Corporation Limited (NTADCL) in environmental management of Tiruppur could have been important. Unfortunately, NTADCL did not incorporate the industrial waste treatment and disposal in their infrastructure development agenda even though it was under consideration in the original plan. The decision by the Court and the subsequent action taken by the TNPCB compelled

the industries to construct treatment plants by mid-1998. Since effluent treatment plants were under construction, NTADCL did not include industrial waste treatment as part of their infrastructure project.

Most of the processing units are using the traditional method of processing (winch) which consume more water and chemical as well as generate more effluent. But the introduction of Cleaner Production (CP) technology in the manufacturing process has a lot of scope. The application of CP in textile industry might include some combination of soft flow machines, low salt dyes and membrane filtration. In soft flow dyeing, the salt and water requirement per kilogram of fabric processed can be reduced up to 50 per cent. With the combined use of low material liquor ratio and low salt reactive dyes, the total dissolved solids (TDS) level of the effluents can be reduced by about 40 per cent (Joseph and Narain, 2000). But the soft flow machine is ten times costlier than the traditional winch.

Generally the large number of small units cannot afford such technology. In the integrated and the large processing units (which are fewer in number), apart from the installation of soft flow machines, certain steps towards CP technology have already been started. But the majority of the smaller units do not have a clear idea about CP. In the present circumstance, CP is only a dream for them since it requires large investment as well as a scientific approach. At present, the industrialists are considering soft flow machines as a business option rather than a resource (water) conservation or a pollution management strategy, because of the higher quality of the final product.

Policy Recommendations

The thesis examined both the development and environment aspects of the Tiruppur hosiery industry in a sustainable development framework. Generally developing countries need to achieve a high rate of economic growth, particularly for solving their poverty and unemployment. Hence in an industrial region like Tiruppur rapid growth is desirable. But when it leads to serious impacts on the environment and imposes large social costs to the society, economic development may become unsustainable. Environment and development are not necessarily in conflict. But serious efforts have to be made to integrate environmental concerns into the decision making process to ensure that development is sustainable.

Environmentally sustainable industrial development is important to preserve the long term interest of the communities who depend on the industry as well as the communities whose livelihood are affected because of pollution. Moreover it can also help to preserve the physical environmental quality (a precious natural asset) of the Tiruppur region. Overseas importers and consumers have also become more concerned about the environmental aspects of manufacturing of the products which they are importing or using. It is very urgent to frame some strategies towards achieving the sustainable development in Tiruppur. This could be possible only through considerable changes/ modifications through policy and institutional initiatives in various areas related to industry and environment. Following are some policy suggestions to achieve environmentally sustainable industrial development of Tiruppur.

- Integrated Production Approach: - The dereservation of hosiery from SSIs and manufacture in the large-scale integrated units

is an ideal solution for manufacturing high quality garments at minimum cost. Moreover through vertical integration, the units can adopt effective environmental management steps to meet the standards. In an integrated unit, the pollution abatement cost has become a part of its overall textile manufacturing cost and therefore the burden is less. Moreover an integrated unit has to think about social accountability and image building.

- Cleaner Production (CP) Technologies: The introduction of CP technology in the manufacturing process may be the only effective long range solution for reducing the pollution problems of textile industries and achieve sustainable development. Even though soft flow machines are capital intensive, they are economical in the long run and also environment friendly. Adequate efforts from the concerned agencies are required towards the widespread application of CP in textile processing.
- Extend Pollution Abatement Cost in to the Full Textile Value Chain: - The responsibility for pollution management, should be shared by the full textile value chain. The present practice of imposing the full cost of pollution management on the Dyers' Association should be changed. Textile processing management should become the collective responsibility of the full hosiery industry. The other textile industry associations need to cooperate with the Dyers Association and provide adequate technical guidelines and financial support towards pollution management.
- Strict Enforcement: - The role of the Pollution Control Board is critical in pollution management and it should strictly enforce

all the pollution control regulations. The TDS standard should be enforced with respect to all the textile processing units after considering the cost of the damage that they may cause.

- Economic Instruments: - Since industries are not meeting the effluent standard for TDS the introduction of economic instruments like effluent taxes, fines or compensation to the affected parties could act as an important incentive towards pollution management. The burden of treatment cost, particularly the variable costs, is more for the smaller units. Hence the introduction of subsidies to small units for treatment will serve as an incentive towards the proper functioning of the plants.
- Integrated Stakeholders Efforts: - All Government departments who have a link with hosiery industrial development and environmental aspects should come forward and work together to solve the environmental problems of Tiruppur. Moreover the local administration and NGOs need to create more awareness about the seriousness of environmental damage in the Tiruppur area.
- Public-Private-Partnership Project for Industrial Waste Management: - Since the existing institutions for pollution management are facing serious problems, the further possibility of incorporating the industrial waste (both liquid and solid) management issues in the Tiruppur Area Development Project should be reexamined.
- Role of Importers:- Since Tiruppur is a major export centre the role of overseas buyers and consumers in pollution management is important. If they boycott the products, which generate

environmental problems in the manufacturing countries, it will create pressure on the industrialists and exporters. Foreign consumers in future may demand 'eco-friendly' products with 'green labels' which carry a premium. The green labels should consider the process related environmental aspects along with the product quality.

- Applications of Natural Dyes:- Natural dyes are an eco-friendly substitute of synthetic dyes, and are less harmful. Adequate research is needed towards the economical application of natural dyes in the processing of different textiles.

Recent Developments

In response to a writ petition failed by the Noyyal River Ayacutars Protection Association on 2003, the Madras High Court constituted an Expert Committee on May, 2005 to go into the question formulated by the court. The major task for the six member committee is to suggest the action plan for remediation of Noyyal river and Orathapalayam reservoir and to inspect the Tiruppur industrial cluster and suggest ways and means for preventing the discharge of polluted trade effluent directly or indirectly to the Noyyal river.

Recently, the court insisted that all the IETPs and CETPs should follow 'zero discharge' for protecting the environment and accordingly most of the units started the preparations for installing the reverse osmosis (RO) plants. Sanker (2001) estimated the capital cost of RO treatment per KL of wastewater treated varies from Rs. 8.74 for the largest CETP to Rs. 31.11 for the smallest CETP. The corresponding variation in gross operating cost is from Rs. 10 to Rs. 12 per KL. The major advantage of the RO plant is that 80 per cent of the water can be recovered and re-used. Since the average cost of RO treatment (Rs. 21.4/KL) is less than the cost of the fresh water which industries are paying (Rs.30/ KL) it is economical. But financing the initial investment, are major constrains. Subsequently, in August, 2005 the Madras High Court also formed a monitoring committee basically to evaluate the progress in installation of RO plants by Tiruppur units and its efficiency in achieving zero discharge.

Another agency set up by the Supreme Court, the Loss of Ecology Authority (LEA) calculated the compensation to the pollution affected farmers in the downstream of Noyyal basin on the basis of productivity loss of different crops as well as the average level of pollution in the villages. The Authority estimated the damage cost as Rs. 24.8 crore for the period 2002-04 to a total of 28,596 farmers located in 68 villages in 7 taluks in Noyyal river basin. The industries as well as the farmers have challenged the award on various grounds, and the case is currently being heard in the Madras High Court.

End Notes

1. Sustainable Development defined as "development that meets the need of the present generation without compromising the ability of future generations to meets their needs" (WCED, 1987). It aims for equitably meet development and environmental needs of present and future generations.

2. Small Scale Industries (SSIs) are units whose investment on plants and machinery is not more than Rs. 100 lakhs. In the present study all the textile processing units which come under the small scale sector do not necessarily meet the official definition of SSI. The majority of the units (around 90 per cent) would fall in the tiny (investment on plants and machinery of not more than Rs. 25 lakhs) classification of the government. We use the term "small scale" in the generic sense of the word, and not in terms of the official definition.

3. The Tiruppur Area Development Project (TADP) is a mega water supply and sewage treatment project and implemented through the New Tiruppur Area Development Corporation Limited (NTADCL), a group of public and private entities. The project bringing 185 mld of water from the Cauvery river (55 km. away) to Tiruppur for industries and households. Out of the 185 mld water, 115 mld has been allotted for industries with a tariff of Rs. 45 per kilolitre. Unfortunately due to the lack of demand for the TADP water, the agency reduced the tariff by around 50 per cent. The total cost of the project is Rs. 1023 crore.

4. Reverse Osmosis is a membrane filtration system which is effective in removing the total dissolved solids. The main advantage of RO is that the final effluent is clean water which can be recycled. The rejects from the RO have to be put through an evaporator if zero discharge is to be achieved.

5. Ground Water Pollution studies carried out by Government Departments include Central Ground Water Board 1983, 1993, and 1999, Tamil Nadu Water Supply and Drainage Board 1999, 2001, and 1995-2001 and the Public Works Department 2002-03. Jayakumar *et al.* 1978, Jacob 1998, Rajaguru and Subburam 2000, Senthilnathan and Azeez 1999, CES 1996, Azeez 2001, Ramasamy and Rajaguru 1991, Jacks *et al.* 1995, Furn 2004, and Berglund and Nina 2004 are studies by researchers and academic institutions.

6. Surface Water Pollution studies done by Government Departments include Public Works Department - Environmental Cell - 2001, Tamil Nadu Pollution Control Board 1997-99, Hydrology Research Station – Fisheries Department - 1995, Soil Testing Laboratory 2000-01, Central Water Commission 2000-01. Palanivel and Rajaguru 1999, Jacob 1998 are studies by researchers.

7. The soil quality study in Noyyal river basin was carried by the Soil Survey and Land Use Organization (SS&LUO), Department of Agriculture, Government of Tamil Nadu during 2002. Around 660 surface and sub-surface soil samples from the basin were tested.

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