SMI CLUSTER ACTION PLAN: A HOLISTIC APPROACH TOWARDS SUSTAINABLE DEVELOPMENT

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INTRODUCTION

According to WCED (1987), sustainable development meets the needs of the present without compromising the ability of future generations to meet their own needs. Sustainable development is a stimulating and inspiring concept that interlinks economic, social, and environmental development issues and satisfies people's need. It goes beyond resources and environmental conservation.

Sustainability assessment can help evaluate and optimize the integration of sustainable development in existing planning and decision making process. Depending on the accepted framework for sustainable development, indicators need to be put forward. Also, short-term and long-term goals for the indicators need to be set. These indicators and the set goals could vary depending on the scope of the project's activities. The strategies to reach these goals need to be devised based on the assessment of existing resources and drawing of action plans to achieve these goals.

This paper shows how sustainable development concept can be integrated for the growth of small and medium scale industries (SMI) using a cluster system to overcome various constraints. The effective management of cluster could offer a significant impact on market competitiveness and economic performance (Alvarez, 2005). However, the need to incorporate the value of sustainability in cluster sector is necessary especially if the resources are used extensively. This is illustrated using a case study from South India, Tirupur. The Tirupur's textile cluster is presented with a goal in enhancing this sector towards industrial sustainability. This is discussed to illustrate the role of sustainable planning in recognizing industrial sustainability.

THE CLUSTER APPROACH

The term 'cluster' in the economic context refers to industry sector related through formal production linkages regardless of geographical location. Porter (1998) popularized this term in economic development thinking. *Cluster* is a geographically proximate group of interconnected companies and associated institutions in a particular field, linked by commonalities and complementarities. Clusters are not considered as unique but they are highly typical that reveals an enduring competitive advantage.

The most dynamic feature of industry clusters is its ability to foster improvement efficiently, promote innovation, catalyzes economic transformation, and enhances stability. This attractive characteristic is a direct result of competitive and cooperative relationships, wherein a cluster develops. Proximity encourages intense competition among rival firms, leading to technological advancement within the industry. Communication with suppliers is enhanced, improving supply channels and promoting cooperation in research and development efforts. Additionally, the industry's importance to the local economy can lead to the formation of supportive relationships between firms and local universities and institutions. The result is a critical mass of industry-related information from markets to industrial processes. The knowledge can be exchanged and held among the cluster's firm acts to further augment competitive advantage.

The primary benefits that can be derived from cluster can be summarized as productivity gain, innovation gain, and new enterprise creation. Productivity gains emerge when companies began to operate more productively using quality sourcing inputs; accessing information, technology, and needed institutions; coordinating with related companies; and measuring and monitoring improvements (Porter, 1998). Innovation gains come from proximity among customers, suppliers, and knowledge centers in which their direct and easy interaction may lead to innovative specifications and responses. Moreover, innovation that occurs within a cluster can lead to the development of entirely new industries, or "spin-offs," which in turn benefit from the region's specialized inputs. New enterprises are easily formed where better information about innovative potential and market opportunities are locally available. This therefore expands and strengthens the cluster itself. A cluster in itself can be an important initial market. Familiarity with local public, venture capital or business angel funding sources may speed up the investment process and minimise risk premiums for new start-ups and growing businesses. Clusters attract outside firms and foreign direct investors who perceive benefits from being in a specialised, leading-edge business location. These may also be a further source of corporate spin-off businesses.

Bekar and Lipsey (2001) advocate that given the advantages of clusters, the government should be well informed of the important role of cluster's can play from a policy stance. Roelandt, et al. (2000) are of the opinion that clustering and networking basically is a bottom-up, market-induced and market-led process in which the primary task of government is to facilitate the dynamic functioning of markets and ensure the cooperation does not lead to collusive behavior which restricts competition.

TEXTILE CLUSTER IN TIRUPUR, INDIA

Tirupur is a textile city in Coimbatore district of Tamil Nadu and is popularly known as Knit City or Cotton City and it is considered as "Hosiery Center". Tirupur is situated 50 km east of Coimbatore and has a population of about 0.35 million. Due to rapid industrialization and migration of labor/businessmen from neighboring cities, Tirupur's population has grown at the rate of 52.36% over the last two decades. Generally, the Tirupur's geographical condition (climate, soil, etc.) is conducive for the cultivation of cotton for textile industry.

The textile industry is one of the largest and most prominent sectors of Indian economy in terms of output, foreign earnings, and employment generation. This industry accounts for about 14% of the total industrial output and nearly 4% of India's GDP. Exports from the textile sector have increased from US\$ 5.07 billion in 1990-1991 to around US\$ 12.5 billion in 2003-2004. This increased amounted to nearly 20% of India's total exports. The readymade garments segment contributes about 40% of the total textile exports from India. This sector employs about 30 million people, making it the second largest employment provider after the agriculture sector (BT, 2004).

Prior to the 80s, Tirupur was mainly producing under garments. viz., banians and underwears consumed largely by the domestic market. In the early 80s, however, it started to extend its services to exporting knitwear, mainly basic T-shirts, in small quantities. In late 80s, knitwear industry diversified very quickly and took up manufacture and export of other outer garments viz. cardigans, jersey, pullovers, ladies blouses, dresses and skirts, trousers, nightwear, sportswear and even industrial wear. This was made possible with the commendable interest shown by the entrepreneurs and with the support from the Government in the form of higher investment limits which allowed for ancillary industrial undertakings to avail facilities of SSI units. Thus, the industry grew remarkably (AEPC, 2003). Exports rose from around 17 million pieces in 1985 to 370 million pieces which corresponds to US\$ 793 million during the year 2003 which was about 43% of all knitwear exports from India (Table 1). Thus, Tirupur is a major center for domestic and export oriented knitwear, sports, and casual garments in South India and the whole country as well.

Year	Qty. in Million Pcs	Value in Million US\$			
1996	257 (48%)	544 (38%)			
1997	294 (47%)	604 (38%)			
1998	338 (50%)	617 (38%)			
1999	368 (48%)	689 (36%)			
2000	410 (49%)	762 (37%)			
2001	372 (52%)	719 (40%)			
2002	348 (53%)	667 (42%)			
2003	370 (55%)	793 (43%)			
Note: Figure in parenthesis indicate overall knitwear export from India					

Table 1: Knitwear exports from Tirupur (1996-2003)

The total number of industrial units in Tirupur, inclusive of textile and other industrial sectors (also tiny industries), has shown a steady increase over the years (Fig. 1), specially after 1985 when exports from Tirupur rose. Similarly, in the wet processing sector which includes the dyeing and the bleaching sub-sectors, there was a sharp increase in the number of units after the late 80's (Fig 2).

Various industry sub-sectors within the Tirupur textile cluster have floated industry associations. These industry associations play a very important role for the development of the cluster. For example, helping international customer to buy directly from the manufacturers instead of agents, and facilitating in resolving commercial disputes among member firms (IIED, 2000). Fig 3 gives a pictorial depiction of the institutional set-up of the Tirupur textile cluster.



Fig. 1: Growth of industrial units in Tirupur



Fig. 2: Growth of wet processing units in Tirupur



Fig. 3: Institutional setup of the Tirupur textile cluster

The key reason for the successful phenomenal growth rate in domestic and export markets of knitwear items in Tirupur, ultimately is due to its export culture, availability of raw materials and hosiery yarn, cheap and skilled labors, flexible attitude of entrepreneurs in meeting the buyer's demands, and the close proximity to Coimbatore which is the major center of cotton spinning in India (AEPC, 2003). Moreover, the important growth factors of this cluster are pro-active marketing, adaptation to latest

technology and inter firm production arrangements. Tirupur textile cluster consists of several hundred small firms all along the value chain of hosiery garments production starting from spinning and knitting through bleaching and dyeing to embroidery and stitching. None of the industrial units in Tirupur have one roof processing facilities from yarn to final product. These are supported by many ancillary units devoted to the production of polythene bags, tapes, buttons, printing of labels, cartons and other packing materials. This high degree of vertical and horizontal integration has resulted in a highly flexible production capability. This high level of flexibility allows the textile cluster to accept orders with lower minimum quantity, which is highly appreciated by clients, because it allows them to develop larger sample ranges (IIED, 2000). Furthermore, Tirupur can deliver customized samples in less than 12 hours; half a million pieces in a matter of days. For this reason, Tirupur gain stem from its performance in technology and the quality of its macro economic environment (AEPC, 2003). Almost 56% of India's total knitwear exports came from Tirupur

The industrial units in Tirupur textile sector are classified as small, medium or large depending on their stated electricity requirement from the grid. The wet processing units, which include dyeing and bleaching units, are classified on the basis of their production capacity. Table 2 shows the details for the classification. There are around 4,000 small and medium scale industries (SMIs) in the Tirupur textiles sector, the rest being small and tiny ancillary units. The number of units in textile industry sub-sector is shown in Table 3.

Type of Industry	General Classification	Wet Processing Units Classification		
Small	Low Tension (LT) lines	10,000 meters/day (approx. 600- 800 kg/day)		
Medium	High Tension (HT) lines < 2,000 KVA	30,000 meters/day (approx. 1,500- 2,500 kg/day)		
Large-Medium	-	Up to 50,000 meters/day (approx. 4,000 kg/day)		
Large	HT lines > 2,000 KVA	75,000-100,000 meters/day (approx. 6,000-8,000 kg/day)		

Table 2: Industry classification in Tirupur

Table 3: Textile industry composition in Tirupur

Textile industry sub-sector	No. of units		
Knitting and/or stitching units	2,500		
Dyeing and/or bleaching units	750		
Printing units	300		
Embroidery units	235		
Other (Compating, Raising,	2.000		
Calendering)	_,500		

RESOURCE UTILIZATION IN THE TIRUPUR TEXTILE CLUSTER

The textile sector is a resource intensive industry in terms of energy and water usage apart from other raw materials. The raw fiber undergoes several consecutive processing stages and this can be divided into three distinct stages: (1) raw fiber to yarn production (Yarn production); (2) yarn to grey fabric production (Fabric formulation); and (3) grey fabric to finished fabric production (Wet process and fabrication).

During yarn production, the raw materials, i.e., raw fiber in bales are converted into yarn through the use of electrical energy. The primary process used is spinning and winding. The produced yarn is converted to grey fabric by the use of electrical energy and steam (thermal energy) during fabric formulation. The primary processes involved here are sizing, weaving, and knitting. The final stage (wet process and fabrication) comprises of several processes like de-sizing, scouring, mercerization, bleaching, dyeing, printing, finishing, etc. This stage is highly energy intensive.

Water use in Tirupur textile cluster

Water is a necessary resource in Tirupur textile cluster. Voluminous water is consumed during textile processing especially in wet processing and in boiler for steam generation. With the growth of population and textile industry in Tirupur, the water demand and consumption has increased. Fig. 4 shows the increase of water consumption with time in Tirupur.



Fig. 4: Water consumption in Tirupur

The water supply for municipality consumption was obtained from Bhavani River which is located 54 km away from the city. This water source is shared among industries, domestic, and agricultural activities which resulted in inadequate supply for industrial sector. Hence, water for domestic and industry use are met using groundwater and other sources. Presently, due to excessive water mining, the underground water table in Tirupur has dropped to about 80 m and the recharging rate has been very slow. The groundwater quality has also deteriorated over the years, because until recently untreated effluent from the bleaching and dyeing industries in Tirupur was discharged to the local natural drainage systems. Tirupur now is heavily dependent on water tankers which are delivered by trucks from neighboring areas as far as 60-70 km. More than 600 trucks of water are transported daily to Tirupur at an average cost of around US\$ 15–22 per delivery. It is estimated that the cost of water constitutes 5% of the total production cost of the textile cluster in Tirupur. Almost the entire quantity of water used in the wet processing units end-up as wastewater while there is 10-20% water loss during steam generation due to leakage/evaporation. Other water application that contributes to water loss include: over usage of water in winches, flash streams, water storage in sump and feed water tank, usage of water in garden, labor usage, and improper process sequencing.

Energy Use in Tirupur Textile Cluster

The primary energy requirement for the Tirupur textile cluster is thermal energy (stream) and electricity (Fig. 5). Almost 97% of thermal energy requirement in the Tirupur cluster is met by firewood and the rest by furnace oil. Most of the thermal energy is used by the wet processing units. Firewood is the primary energy source for boilers to generate electricity for wet processing industries. The daily demand for firewood is around 1,000 tonnes. This amount corresponds to about 100 truckloads of firewood being brought to Tirupur each day. About 60% of the firewood comes from 30-45 km from the city. Presently, the average cost of firewood per ton varies from about US\$ 32.6 to US\$ 43.5. Other boiler fuels like diesel and lignite/coal were found uneconomically viable because of its high cost and could cause problems due to carbon particles settling on the bleached fabric, respectively.

Some dyeing/bleaching units in Tirupur have shifted to use furnace oil when its price was low, around US\$ 0.22-0.24 per liter. But, when oil price increased they returned to use cheaper wood-based fuel sources. Though the heating value of firewood is low (2,000-2,500 kcal/kg) compared to coal (6,500 kcal/kg) and furnace oil (8,000 kcal/kg), the sheer volume of fuel usage has forced the industry to consider firewood as their fuel choice.



In terms of electricity, the wet processing sub-sector consumes more (52%), followed by printing and finishing units, garment processing, and knitting units (Fig. 6). At present, there is a gap of 9% between the demand and supply. This has led to high power costs and frequent interruptions and load shedding. It is estimated that with an annual increase in supply (3%) and demand (4%), the shortage can be bridged within a ten year period.



However, a 5% increase in supply would require only four years to bridge the gap (Fig. 7).

Fig. 7: Projected electricity demand and supply

ENVIRONMENTAL CONCERNS FROM TIRUPUR TEXTILE CLUSTER

Airborne related

Prominent causes of air pollution in Tirupur are due to the burning of firewood/biomass in boilers, use of diesel generators to supplement electricity, and due to the high vehicular traffic (both roadways and railways). Based on the annual production and specific emission factors of various sources of energy used in the Tirupur textile cluster, the annual GHG emission from Tirupur has been calculated as follows:

CO_2 emission due to firewood	= 343.31 million kg CO ₂
CO ₂ emission due to furnace oil	= 16.23 million kg CO ₂
CO ₂ emission due to electricity use	= 87.91 million kg CO ₂
Total CO ₂ emission from textile sector	= 0.447 million tons CO ₂

Waterborne/Effluent related

Most of the wet processing units in the Tirupur textile cluster were located near the River Noyyal and Nallar and even now the effluents were directly discharged to these rivers. About 1,500 tonnes of colouring agents are used each year, one fifth of which are flushed along with the wastewater, amounting to 1 ton/day. Because of the sustained release of effluent to the water bodies over the past two decades, the groundwater quality has been affected, as it become brackish and considerably harder.

Based on the per capita water supply levels, Tirupur is discharging daily about 30 million liters of domestic sewage in open drains. Wastewater discharge from bleaching and dyeing units is about 40 million liters/day. This wastewater is untreated and discharged to Noyyal River, dry wells or open lands. Studies on groundwater indicate that open wells

and bore wells in and around Tirupur exhibited high levels of TDS (3,000mg/L to 11,000 mg/L) and Chloride (2,000 mg/L to 5,000 mg/L) due to industrial pollution and these values are much higher than the background level for this region. The water recharging capability in groundwater is very low because the area is dry and now it is considered as inappropriate to be used for domestic, industrial or irrigation purposes. Although, a central effluent treatment plants (CETPs) have been installed, a proper treatment to remove salinity and to determine the concentration of toxic chemicals was not considered, prior to discharging wastewater into a nearby dry river.

Land degradation due to seepage of chemicals and dyes in the soil has decreased average rice yield per hectare (Fig. 8). Today, the farmers depend on rain or flood waters and not on polluted river water for irrigation. This has increased the land area to be left uncultivated; thereby it led to raise food safety concerns. The decrease in agricultural production is also affecting the availability of biomass (crop waste and residues) and increased the demand for other energy sources. As stated earlier, due to acute shortage of water, Tirupur's industries have to buy water from water tankers. This has led many farmers to stop farming and supply water to industries. This has also led to unsustainable manner of water mining. Also, when the water gets too deep to be extracted, the farmers cannot return to farming because the fields are dry.



Fig. 8: Average Rice Yield in Tirupur

Declining forest cover

Biomass/firewood is used as fuel for the numerous boilers and steam units of industries leading to rapid decline of the forest cover (Table 6). Average firewood consumption by Tirupur textile cluster is 596.7 million kg/yr. In addition, insufficient rainfall in the district has caused low fauna growth. Thus, biomass energy availability in the future is also at risk.

Forest crown density	1989	1994	2001			
Low density	7.04	6.34	3.25			
Medium density	5.48	7.96	5.46			
High density	6.23	4.11	1.67			
Total area	18.75	18.41	10.38			
Source: Environmental Information Centre (EIC) 2003. Supply of						
Environmental data For Forest Resources						

Table 6: Crown density of forest with time as % of Coimbatore district

Solid wastes

About 50,000 tons of solid waste is generated every year in Tirupur city. Fig 9a and 9b shows the historic and projected solid waste production from the municipal and industrial sector. The characteristic of these wastes exhibits high fraction of organics, recyclables, and combustibles. At present, there are five dumpsites with a total land area of 8.6 acres for solid waste disposal. Among the important concerns on solid waste management in Tirupur include: (1) solid waste storage or container and collection system is inappropriately provided; (2) insufficient number and kinds of waste collection vehicles; (3) improper solid waste disposal facilities and management. One of the dumpsite used for waste disposal is an abandoned quarry located in residential area. Space for solid waste disposal is now a growing constraint. Unsustainable disposal manner could lead to various pollution problems in air, water, and soil and this needs an immediate attention.





Fig. 9a: Daily Municipal and Industrial Fig. 9b: Average solid waste characteristics Waste Generation (History and Projections)

ENHANCING TIRUPUR TEXTILE CLUSTER TOWARDS INDUSTRIAL SUSTAINABILITY

The important aspects that should be considered in enhancing Tirupur's textile cluster include: the sustainable use of resources mainly water, and energy; improvement of infrastructure in water and wastewater treatment plants; sustainable waste management and disposal; and use of renewable energy. Moreover, from an environmental viewpoint, the primary need in Tirupur's textile industry cluster to attain industrial sustainability is the pollution reduction during the production processes, and protection of the environment by minimizing fresh water consumption and reducing the use of toxic/hazardous chemicals. These can be achieved by adopting individual factory level conventional housekeeping, oriented cleaner production approach; this necessitates significant in-house training and pollution prevention awareness. Considering the nature of SMI, it is more attractive to promote these activities through industry associations through clustering approach. Various strategies that can be adopted to achieve industrial sustainability in the Tirupur textile cluster can be widely categorized into two main areas: (1) energy use, and (2) promotion of energy efficient and environmentally sound technologies (E3STs).

Energy Use

Table 7 summarizes the future development potential of some energy sources to be used in the Tirupur textile cluster. There is a high potential for renewable energy technology applications for firms in the Tirupur textile cluster. One of the attractive options that Tirupur needs to investigate is the waste-to-energy technology. This could serve two purposes; it can manage the waste and at the same time generate energy for useful purposes. The waste characteristics in Tirupur comprises high fraction of organic materials. This is attractive for anaerobic digestion to generate biogas, one form of renewable energy. This can be then used for combustion purposes to generate steam, as well as in the generation of electricity. The combustible fraction can be incinerated or processed for RDF production so that these waste can be converted to energy rather than burying in dumpsites. Moreover, energy generation from wind could support the energy demand in Tirupur sustainably, since the Tamil Nadu is regarded as a major wind energy harvesting state in India. Wind generation may not be affordable for individual units due to very high capital cost associated with these installations. But, as a cluster, the capital and benefits, e.g. tax exception, depreciations, can be shared and adoption can be assisted.

Promotion of E3STs

The promotion of E3STs will incur positive impacts in the adopted processes and machineries/equipments. These significant effects include reduction in power consumption in industrial processes, increase energy efficiency, and reduction in water generation. As mentioned elsewhere, CETPs were already constructed in Tirupur. However this infrastructure needs improvement in terms of treatment technology. A zero discharge scheme should be implemented in the existing CETPs because of its various advantages. However the main drawback is high investment cost. This can be overcome by combining many projects together wherein it can attract funding agency and with the support of government to invest in one big project. The role of the government in policy making is important in the adoption of E3ST in industry cluster sector. The government find interest on this because the clusters offer an opportunity to develop industrial policy

in a strong pro-market environment; help in bridging the 'endogenous' and 'exogenous' approaches to regional development; the cluster chime with the prevailing trend of partnerships, indirect support, and demand orientation; and it fit both in 'bottom-up' and 'top-down' approaches to industrial policy (Lagendijk, 1998). Furthermore, a cluster approach would result in cross-cutting E3STs being more cost-effective, considering their large scale installations. Such large-scale installation of any other measures, e.g. adoption of technology or training, could reduce the overall cost compared to individual SMI.

Source of Energy	Future Development Potential							
Hydropower	Requires a detailed investigation in the nearby Western Ghats							
Coal/lignite	Would be environmentally unsound and unsustainable due to							
	emissions; but available in the country							
Diesel for industry	Unsustainable and can cause environmental problems							
Fuel oil	Reduction in use: unsustainable							
Biomass	Efficiency is to be examined and improved. Biomass							
	development needs an extensive reforestation for fast growing							
	species.							
Waste-to-energy	High potential of incinerating combustible waste for therma							
	and electrical energy							
Wind energy	Large and highly sustainable, potential to meet the growing							
	energy need							
Solar energy	Pre-heating boiler feed water, solar ponds, domestic and							
	commercial lighting, and storage of power for peak loads;							
	extensive development potential							
Petrol/diesel	Development of mass transit system for efficient transpor							
	infrastructure to reduce traffic and fuel consumption							

Table 7: Energy use in Tirupur: Options

CONCLUSIONS

The cluster approach should be an important agenda for governments, companies, and other institutions to explore sustainable development opportunities. Policy support for cluster should consider how national policies are implemented locally in order to maximize their effectiveness in generating economic growth but keeping the underlying sustainability objectives intact. The role of the various local institutions like the industry associations should not be discounted. These organizations maybe required to the implement the policies at the local level either through direct or indirect participation. Networking or reinforcing networks of the various industrial associations, financial organizations, local administrative units etc. will foster the implementation of cluster specific policies thus driving industrial sustainability.

Cluster development initiatives are an important new direction in economic policy, building on earlier efforts in macroeconomic stabilization, privatization, market opening,

and reducing the costs of doing business. This process lays an emphasis on dynamic and reciprocal interrelations among the various organizations comprising the cluster network.

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SMI Cluster Action plan: A Holistic Approach Towards Sustainable Development



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1. Background - Concerns!

Consumption of non-renewable resources, e.g. materials, water & energy, has been increasing dramatically. So, there is serious threat that future generations may not have access to such resources.



2. Sustainable Development

What is Sustainable Development?

"Development that meets the needs of the present without compromising the ability of future generations to meet their own needs"

- Considering well-being of present and future generations
- Maintaining a healthy lifestyle without increasing the use of nature's resources beyond her capacity

Sustainable Technology....? NO...



Sustainable Technology... Yes



2. Sustainable Development

Components of Sustainable Development

Environment aspects
Economical aspects
Social & cultural aspects



How to Address These Issues ?

Set long-term goals

- ✓ Where do we want to go(al)?
- ✓ How far are we from targets?

Understand the problems -A challenging task!

- ✓ Where are we? → Alert us before it gets too bad
- ✓ Which way are we going? → Helps to recognize what needs to be done to fix the problem
- ✓ Look at the life cycle

Roadmap our the resources

- ✓ Inventory the energy and water resources
- List out our demands focus should be on services rather than commodities

Draw action plans

 \checkmark Synchronies the supply and demand

What is Cluster



Visu

Why Cluster?

What is cluster?

✓ Please define what is cluster?

Strengths, Weakness, Opportunity and Threat

Why clusters – SWOT Analyses?

- ✓ Strengths
 - A group is better than individual SMI
 - Better resource management
 - Cost effective: bigger the size, lower the cost
 - Easy to execute
 - Low opportunity costs

Weakness

- Require team effort and extensive cooperation
- Strong networking, sometimes high capital

9

Visu

Sustainable Development Through Local Resources Management: Energy, Water and Pollutions

Case Study A Growing Industrial City Tirupur in India

India's Textile Sector

- ✓ Textiles account for 4% of the GDP
- Significantly contribute to employment generation
- ✓ 30% of India's total exports.
- Foreign exchange earnings of about 15% in India's industrial production
- ✓ 40% of textile exports are from readymade garments

India and Tamil Nadu



Tamil Nadu and Coimbatore District



Comibatore District & Tirupur



Tirupur – Climate

✓The hot and dry climate of the region is one of the factors influencing the cotton crop harvest in the region.

✓Temperature: 20-38 °C

Receives scanty rains as the town is situated on the leeward side of the Western ghats.

✓Annual average rainfall - 617 mm (2004) → Average rainfall of has declined from 927mm in 1971-81 to 600 mm in 1981-91.



Source: Prof.R.K.Sivanappan, "Farming in Wind Farm Lands in Tamilnadu", Indian Wind Power Association, January 2003 Visu 15

Tirupur – Socioeconomic Status

- ✓ Population = 351,501
- Owing to the rapid industrialization, Tirupur has grown at a rate of 52.36% during past two decades.
- Annual average population growth rate_is 4-5 %
- While the overall development patterns concentrated in the central area, the areas along the northern side of the Railway track and River Noyyal have grown rapidly.
- Additional daily labors come from neighboring areas of Coimbatore
- Migration of labor and businessmen from neighboring districts and states

Tirupur - Population

Population (2001) = 351,501



Tirupur Textile Sector Overview

Products:

T-Shirts, Pullovers, Cardigans, Nightwear, Baby wear, etc.

Production capability

✓ 810 Million pieces (Export - 70%)

I ncome generation:

✓ Rs.70 Billion (Export earnings 71%)

No of SMI s:

✓ XXX

Knitting and / or stitching units	2500	
Dyeing and / or bleaching units	750	
Printing Units	300	
Embroidery units	235	
Other (Compacting, Raising, Calendering)	200	

Number of industries in Tirupur

Source: Tirupur Dyer's Association

Approach

SMI Cluster Action plan: A Holistic

Tirupur Textile Sector Growth





Tirupur Textile Sector Growth



Source: Tirupur Dyer's Association

Characteristics of Tirupur Cluster

None of the unit in Tirupur have one roof processing faculties from yarn to final product. It's a cluster "independent" chain process

- ✓ SMI 1: Yarn dyeing and/or bleaching
- ✓ SMI 2: Knitted or weaving
- ✓ SMI 3: Calendaring (steam-ironed)
- ✓ SMI 4: Printing

✓ _____



✓ SMI ...: Cutting, stitched and finishing.

Tirupur - Water Resources

- ✓ Water is life blood of Tirupur textile cluster.
- Typical water consumption is 200–400 liters per kg of finished goods (whereas the international norm is 120 – 150 liters/kg)
- Major part of water is used for wet processing and boiler feed.
- ✓ Almost the entire quantity of water used in the wet processing end-up as wastewater while 10-20% lost through steam leakages/evaporation. Other water application/loss include:
 - ✓ Over usage of water in the winches
 - ✓ Flash steam
 - Leakage of water
 - Some amount of water storage in the sump and feed water tank
 - ✓ Usage of water to the garden
 - ✓ Labour usage
 - ✓ Improper process sequencing

Water Use in Tirupur

- Tirupur textile industries consume daily about 100 million liters of water
- ✓ City lacks adequate water supply and hence the industries are depending on groundwater and neighboring districts.
- Daily more than 600 trucks of water is transported to Tirupur from over 50 km away (each delivery costs about US\$ 15-22)
- ✓ Cost of fresh water constitutes about 5% of the total production cost.
- ✓ Treating wastewater and effluent is about 2% of production cost

Water Consumption in Tirupur



Tirupur - Water Demand

- Higher water demand = higher energy use for pumping, treatment and transport costs
- ✓ Cost of industrial and agricultural production increases



I ncrease of industrial share causes shortages in municipal and agricultural supply.

Water Use in Tirupur

The large number of bleaching and dyeing industries of the town is affected by the quality of ground water owing to the untreated Tirupur Water quality:

SI. No.	Parameter	Bore wells	Open wells	
1	рН	7.5	7.6	
2	Chloride	2038.5	4676	
3	Sulphate	35.04	63.4	
4	Calcium	203.6	219.8	
5	Magnesium	407.2	345.84	
6	Iron	0.8	0.6	

Source: Tirupur City Corporate Plan, "Basic Services and Infrastructure Element"

, http://www.tn.nic.in/tnudp/tiruppur.htm

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Water use in Tirupur

Industrial wastewater

- More than 140 L/kg of hosiery produced
- ✓ High TDS content (6000-12000 mg/L) in the effluent
- Dye content (heavy metals) and bleaching chemicals

Municipal wastewater

- ✓ 90-100 L/capita.day (less than average)
- ✓ Increasing population and unorganized urbanization leading to lack of wastewater collection







Energy use patterns: Average specific energy consumption



Energy use patterns: Average specific energy consumption



Energy use patterns: Average specific energy consumption



Electricity supply and demand

Energy

- ✓ Higher power costs, interruptions or load shedding
- Increased diesel, LPG use and CO₂ emissions, air/noise pollution in the locality

Annual increase in demand by 3%, the shortage of 9% can be bridged by annual increased supply of 4% within a 10 yr period.

Annual increase in supply by 5% would take 4 yrs to meet it





Energy inefficiency

Actual & I deal details of boiler in Tirupur processing industries

Type of boiler	Feed water temp. (°C)	(Boiler efficiency		Excess air (%)		Flue gas Temperature (°C)	
			(%)		Actual	I deal	Actual	l deal
Firewood	31		27.5		400	50	139	120
Firewood	95		54.7		128	50	205	120
Firewood	70		41.9		331	50	140	120
Furnace oil	78		68.0		114	50	168	120
Firewood	38		23.2		303	50	170	120
Firewood	70		29.7		505	50	160	120
Firewood	70		20.2		177	50	300	120

Source: * PSG College of Technology, Coimbatore, India

Boiler efficiency variations: 23 - 68 %

SMI Cluster Action plan: A Holistic Approach

Textile industry pollutions

One kg product output Consumes

- ✓ 8 kWh of energy
- ✓ 160 liters of fresh water

Discharge

- ✓ 140 liter wastewater
- ✓ 0.4 kg solid wastes

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Approach SMI Cluster Action plan: A Holistic

Environmental Concerns - Waterborne

- About 1500 tonnes of coloring agents are used each year, one-fifth of which is flushed into water amounting to one ton per day.
- Most of the processing industries are located in clusters near the rivers (Noyyal & Nallar), into which they discharging the effluent.
- Local groundwater has become brackish and considerably harder over the past 10-15 years.

With no freshwater available for dilution, the groundwater from Coimbatore and *Tirupur is no longer suited for irrigation*.

Environmental Concerns - Waterborne





Excessive withdrawal is decreasing the depth of ground water table.

Groundwater quality in Tirupur (Total dissolved solids)



Year

Surface discharge of industrial wastewater increases total dissolved solids in well water.

Tolerable values = 500 mg/L

Declining Forest Cover



SMI Cluster Action plan: A Holistic Approach

Visu

Changes in land use pattern

Changes in land use pattern, fallow land and non-agriculture use increases.



Tea garden

Others: include deforestation or use or agriculture land for settlement, infrastructure, etc

Changing land use pattern in Coimbatore district



Decline of Agriculture Production

Average rice production in Tirupur



Land degradation due to seepage of chemicals and dyes in the soil has decreased average rice yield per hectare. The farmers depend on rain or flood waters and not on polluted river water. Forest cover decreased due to encroachment.

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Infrastructure – Wastewater treatment plants Number of treatment plants (CETPs) in Tirupur



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CP options...



Some options for Tirupur's Industrial Sustainability...

Energy Efficient and Environmentally Sound Technologies:

- ✓ Reduce power consumption in industrial processes
- ✓ Increase energy efficiency of machines
- Install incinerators for combustible municipal and industrial waste disposal
- Use organic municipal waste to obtain biogas and compost for organic farming
- Reduce fuel consumption by replacing fossil fuel with renewable energy
- Change technology or process to reduce water consumption (reduce energy required for water use)
- Provide secondary and tertiary wastewater treatment facilities to meet the standards
- ✓ Reduce water use and recycle water

Tirupur: Renewable energy - Wind

Wind velocity in Coimbatore*

Normal wind speed = 30 Km/h Highest wind speed = 60 Km/h

Wind mill area in Coimbatore District*:



Palladam, Sulur, Udumalpet & Pollachi, Edayarpalayam,

Ketahnur, Kamalampatti, Elavanthy, Poolavadi etc.

Total installed capacity of wind farm of Tirupur = 4.100 MW**

Tirupur textile sector contribution = 2.225 MW**

Power generation from wind farms = 13 million kWh/year (approx.)

Wind energy potential in Tirupur = 25.04 MW*** (From Tirupur (4.1 MW) or Textile sectors (2.225 MW)?)

Tamil Nadu is a major wind energy harvesting state in India!

Source: * Prof.R.K.Sivanappan, "Farming in Wind Farm Lands in Tamilnadu", Indian Wind Power Association, January 2003 and **"Directory on Indian Wind power 2002" *** Estimated Value

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Tirupur: Energy from biomass UTILIZATION OF WASTEWATER FOR PLANTATION IN OWN LAND



Tirupur: Energy from biomass

UTILIZATION OF WASTEWATER FOR PLANTATION IN OWN LAND



Tirupur: Energy from biomass UTILIZATION OF WASTEWATER FOR PLANTATION IN OWN LAND



Source: PSG College of Technology, Coimbatore

Tirupur: Wind Energy Potential





Tamil Nadu is a major exploiter of wind energy in India

Characteristics	Poor <6 m/s	Fair (6-7 m/s)	Good (7-8 m/s)	Very Good (8-9m/s)	Excellent (>9 m/s)
Land Area (%)	35	20	20	20	5
Wind Potential	NA	4.1	1.06	8.1	0.45
(MW)					

Energy Efficient Environmentally Sound Technologies (E3STs)

✓ From an environmental point-of-view, the main need for the textile industry in Tirupur is to reduce pollution in the production processes and to protect the environment by reducing the amount of fresh water used and reducing the use of toxic and hazardous chemicals. This can be achieved by;

- Use of adequate equipment and machinery
- Good Housekeeping measures,
- efficient use of materials and assessment of environment impact
- ✓ reduction, reuse, and sound treatment of waste
- appropriate storage, handling, and transport of materials
- reduction of water consumption, waste water, and pollution
- reduction of energy consumption, use of waste heat and environmentally-sound sources
- ✓ workplace safety and health protection



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CP- Policy Options



Waste segregation

Visu

Sustainable planning scenario

- 1. Energy Emission scenarios
- ✓ Adopt E3ST on a mass scale, e.g. replacing all boiler with an efficiency of less than 50% → emission look
- Explore renewable energy,
- Energy from solid waste
- Energy from effluent, e.g. CH₄, for boiler fuel
- Replace firewood with diesel
- ✓ Wooden biomass from plantation that use water from waste treatment plant
- 2. Water treatment and relying
 - ✓ Recycling all wastewater and reuse within factor → change in water demand

GOpportunities

Create market competition through cost-cutting

Improvement in environmental standards

✓ Govt. can easily enforce the compliance standards thereby improve overall environmental benefits

Wind energy can be explored

 SMIs cannot always afford to install wind energy due to high capitals. But, as a cluster, the capitals and benefits, e.g. tax exception, depreciations, can be shared

Potential to acquire easy financial resources

 The funding agency may deal with one big project rather than so many small projects

Concluding remarks

- Cluster approach should be an important agenda for governments, companies, and other institutions to explore sustainable development opportunities.
- Policy support for clusters has to take account of how national policies are implemented locally, in order to maximize their effectiveness in generating economic growth.
- Cluster development initiatives are an important new direction in economic policy, building on earlier efforts in macroeconomic stabilization, privatization, market opening, and reducing the costs of doing business.



Environment/Economy/Social

