

Section I

Introduction and understanding of the project

Approval

This dissertation titled ‘The designing of an Eco industrial park’, a study with reference to Auroville, done by Miss Avani Sheth, is hereby approved as a creditable work on the approved subject carried out and presented in a manner, sufficiently satisfactory to warrant its acceptance as prerequisite to the diploma for which it has been submitted.

It is to be understood that by this approval the undersigned do not necessarily endorse or approve any statement made, opinion expressed or conclusions drawn therein, but approve the study only for the purpose it has been submitted and satisfies itself as to the requirement laid down by the dissertation committee.

Examined by: -

External guide: -

Internal guide: -

Acknowledgements

- I would like to thank my guides Ar. Lalit Bhatia and Ar. Anupama Kundoo for giving me inspiration and encouragement, besides their invaluable guidance in this endeavor.
- I am deeply indebted to my internal guide Miss Preety Shah for helping me when I was absolutely lost.
- I would also take this opportunity to thank my friends and parents for their support, which has helped me significantly in the fruition of this dissertation.
- Finally there is Ronak to thank, who has always been there for me. Had it not been for his presence, I would have never been able to learn and understand many finer aspects of my thesis.

Preface

Symbiosis is one of the natural world's truly beautiful systems. In reality, this principle of dynamic natural relationships exists not only among plants and animals but also applies to animals and humans, humans and humans, companies and industries, industries and environment, humans and the earth. It is this very relationship expressed in the term "symbiosis: ism, which is our goal for bringing about better business global partnerships. Though both free competition and harmony, based on a spirit of mutual benefit and trust, the Eco industrial park will continue to make these interactions more productive and fruitful for our lives.

Ch. 1. Introduction to an Eco industrial park

1.1 Aim

Topic selected is to design an Eco industrial park in the industrial zone of Auroville Township in the state of Tamilnadu located very near to Pondicherry.

1.2 Introduction

The climate change, local air pollution, loss of bio diversity and ecosystems, degradation of farm land, and massive depletion and waste of natural resources are some of the environmental signs of the system's failure to respect the natural constraints upon human activity.

Powerful arguments against this are needed for development as a means, not as an end in itself that takes precedence over environmental and human values.

Put very simply, the goal is to reintroduce materials and energy back into productive reuse with the minimum energy required and the least waste of material in the process.

Why? Because we waste far too much! Actually we are more than ten times better at wasting resources than at using them.

The end concern of industrial ecology is actually fairly easy to state. The goal, at the minimum, is to generate the least damage in industrial and ecological systems through the maximum circulation of materials and energy. Highest value use with the least dissipation of resources forms the core of systematic application of industrial ecology.

1.2.1 The present state of our industries

The present trend of urban and industrial development evidently is not environmentally friendly. The lifestyle, the attitude of the industries, their demands and dependence and the highest level of consumption are not sustainable. The strain on the infrastructure demand is increasingly hard to meet satisfactorily.

While the price the industries must pay for scarce resources are on the steady increase, there is a larger price to be paid by the rest of the world in not only money terms. The awareness is not only lacking in the beneficiaries but also in their appreciation of the value of the resources they thoughtlessly deplete. So that they at least prevent wastage, but there is also on significant effort to reduce such a strain in the future planned development through systematic analysis and corresponding amendments in the building bylaws etc. further there is a need for active promotion of sustainable development approach to those who are aware but face various obstacles in the realization of alternative technologies in the midst of prevailing other trends and value systems.

Most of the industries today let out harmful waste posing a threat to our natural surroundings and creating environmental polluting.

Soil, air and water when polluted enter the food chain and in the process are unhealthy for not only the human beings but also to the simplest form of living organisms.

Human beings have altered the balance of nature to their own interests by developing their industries. Climate change on a great scale will almost certainly disrupt the delicate balance of plants and animal habitats, leading to extinction of increasing number of species.

The world's developed countries are starting to look at ways to reduce the enhanced green house effects. Industries are beginning to use fewer and cleaner fuels and phasing out CFC's, which until recently were used in aerosols and in refrigeration and foam-plastic manufacturing. Automobile manufacturers are making their vehicles more fuel-efficient.

Most of us are beginning to realize that we must use scarce resources wisely and consider the impact our activities are having on what is probably the only planet in the solar system sustaining life.

1.2.2 Infrastructure analysis and corresponding interdependence

Integrated thinking considers waste as a part of the local ecology, providing treatment while generating useful byproducts.

There is a direct relationship between wastes generated and the demands of the industrial park in terms of water and energy. Therefore in an integrated approach they are necessary to be reviewed side by side rather than one after another in order to make the optimum decisions. While treating the waste in the appropriate way, it is possible to meet a part of the water and energy demands and subsequently reduces the strain on these valuable natural resources.

For example in this case, the wastewater from the paper and cloth industry can be treated and reused for gardening and toilet flushing. Sewage from the housing can be processed in a bio gas plant and transformed into energy for the boilers of the industry, cooking and lightening. The other valuable byproducts of rich compost from the housing and the industry can serve as manure to the gardens and landscaped areas. Much of the solid waste obtained can be used to make bio coal fuel, which generates non-polluting energy when burned. All the dry garden waste is used in the paper industry for making handmade paper of various kinds as per the raw materials. The handicraft industry uses all kinds of leftover pieces to make products of artistic quality.

After all the waste water is reused, the surplus water demand can be met as far as possible by harvesting of rain water thereby relying on the ground water only for the needs demanding very clean water. Further the ground water that is used must be recharged while percolating all the surplus surface storm water within the site limits.

Similarly the energy obtained by converting wastes is used to cut energy demands. The remaining energy demands are to be met as far as possible by the renewable sources such as wind and sun.

1.3 What is an Eco industrial park?

An Eco industrial park is a community of manufacturing and service businesses seeking enhanced environmental and economic performance through collaboration in managing environmental and resource issues including energy, water, and materials.

By working together, the community of business seeks a collective benefit that is greater than the sum of the individual benefits each company would realize if it optimized its individual performance only. The critical element in defining an EIP is the interactions among its member businesses and their natural environment.

The goal of an EIP is to improve the economic performance and participation of the companies while minimizing their environmental impact.

Components of this approach shall include new or retrofitted design of park infrastructure and plants; pollution prevention; energy efficiency; and inter-company partnering.

Through collaboration, this community of companies becomes an “industrial ecosystem”.

Some common characteristics for the development of an Eco industrial park will be:

- A single by-product exchange pattern of network of exchanges
- A recycling business cluster(resource recovery, or recycling companies)
- A collection of environmental technology companies
- A collection of companies making green products
- An park with environmentally friendly infrastructure or construction
- A mixed-use development(industrial, commercial, and residential)

Here a community of companies works together making the most efficient use of energy, material flow and transportation, park management and support services. They seek to minimize the impacts on the industry as well as the ecosystem by careful site preparation with using sustainable design techniques and construction.

Ch. 2. The importance of an Eco industrial park

2.1 Why is an EIP needed?

For the companies involved, the Eco industrial park offers the opportunity to decrease production costs through increased materials and energy efficiency, waste recycling, and elimination of practices that incur regulatory penalties. Increased efficiency may also enable park members to produce more competitive products. In addition, some expenses once occurred solely by individual businesses may be shared by firms in the park.

These may include shared waste management teams, environmental information systems, and other support services. Such industrial cost sharing could help park members achieve greater economic efficiency than their stand-alone counterparts.

It will play an important role in benefiting the environment as well as the society, which is very much needed in the present scenario as we find our pollution levels rising.

2.2 Principles of industrial ecology

2.2.1 Connect individual firms into industrial ecosystems

- Close loops through reuse and recycling
- Maximize efficiency of materials and energy use
- Minimize waste generation
- Define all wastes as potential products and seek markets for them.

2.2.2 Balance inputs and outputs to natural ecosystem capacities

- Reduce the environmental burden by releases of energy and materials into the natural environment
- Design the industrial interface with the natural world in terms of the characteristics and sensitivity of the natural receiving environment.
- Avoid or minimize creating and transporting toxic and hazardous materials.

2.2.3 Re-engineer industrial use of energy and materials

- Redesign processes to reduce energy usage
- Substitute technologies and product design to reduce use of materials that disperses them beyond possibilities of recapture.
- Dematerialization(do more with less)

2.3 Key Trends

The major trends described in this transition toward a sustainable economy in terms of four potential design strategies:

- 1) Increasing efficiency and use of renewable energy and material resources;
- 2) Designing of communities and the built environment using ecologically aware methods;
- 3) Sustaining and renewing natural systems; and
- 4) Redesigning of public and private sector organizations.

2.4 Industrial ecology

Industrial ecology is a dynamic system based framework that enables management of human activity on the basis by:

- Minimizing energy and materials usage
- Ensuring acceptable quality of life for people
- Minimizing the ecological impact of human activities to levels natural systems can sustain
- Maintaining the economic viability of system for industry, trade and commerce.

The industrial ecology approach involves:

- Application of system science to industrial systems
- Defining the system boundary to incorporate the natural world
- Seeking to optimize that system

This is to act as ecosystems where production and decomposition are well balanced and nutrients recycle continuously to supply the next cycles of production. Industrial ecology offers a theoretical foundation as well as tools to support the transformation to a sustainable industrial system that operates in such a balanced fashion.

2.5 Design for environment

Design for environment is a stream of work in industrial ecology with very direct application to EIP planning. Evolving out of product life cycle analysis and concurrent engineering, this work considers all potential environmental implications of a product: energy and materials used in the product, its manufacture and packaging, transportation, consumer use, reuse or recycling, and disposal.

As a designers point of view application of this holistic process to resolve EIP trade –off issues in infrastructure, site design, buildings, and other park systems. Making design judgements about these trade off requires a sophisticated system, balancing diverse issues including: the burden on virgin resources, energy use at each stage of the construction materials lifecycle, materials recyclability, construction processes, and costs.

Design for environment offers system analysis tools to integrate decision making across all environmental impacts of a product. Adapted to industrial park and building design, it can include design for reuse, reconstruction, and demolition; and a means of achieving higher efficiency and resilience throughout a projects life cycle.

This method also enables designers to consider the traditional design issues of construction process, cost, and quality as part of the same decision system. Thus equipped, designers will be better able to enhance environmental performance while keeping prices competitive.

2.6 Pollution prevention

Pollution prevention is another important foundation for Eco industrial parks, particularly in terms of the design of industrial processes within plants. This approach has led to development of many strategies, assessment methods and a wide range of clean technologies that often improve both environmental and economic performance.

Companies that adopt Pollution prevention approaches are enjoying many benefits including reduced waste disposal and raw material costs; improve worker safety and better public image. Many firms have developed company wide, systematic Pollution prevention programs that include a detailed investigation and assessment process, employee training and incentives, and setting Pollution prevention goals.

Companies often adopt cleaner production technologies like switching from their present methods to Eco technologies.

To guide companies in identifying pollution prevention opportunities and hierarchy is created that builds environmental protection into the industrial waste management process. It places highest priority on reduction of hazardous wastes at the source and internal recycling rather than treatment and/or disposal of wastes to land, air and water. The strategies, from least favorable are:

- Source reduction
- Recycling
- Treatment
- Disposal

A related issue is waste and material exchange between companies.

Waste exchange, although not an official Pollution prevention strategy, is generally encouraged and is helpful as an alternative to treatment and disposal after source reduction opportunities have been exhausted.

However, many regulatory barriers exist that discourage material and waste exchange essentially, complying with liquid waste, solid waste recycling and transportation regulations often offset any economic benefit companies might enjoy by trading materials and wastes.

Ch. 3. The development of an EIP

3.1 How to develop an EIP?

3.1.1 Strategies for designing of an Eco industrial park

Several basic strategies are fundamental to developing an EIP or industrial ecosystems.

Individually each adds value; together they form a whole greater than the sum of its parts.

a) Integration into natural systems

- Minimize local environmental impacts by integrating the EIP into the local landscape, hydrologic setting, and ecosystems.
- Minimize contributions to global environmental impacts, i.e. greenhouse gas emissions;

b) Energy systems

- Maximize energy efficiency through facility design of rehabilitation, co-generation, energy cascading and other means;
- Achieving higher efficiency through interplant energy flows;
- Use renewable sources extensively;

c) Materials flow and waste management for the whole site.

- Emphasize pollution prevention, especially toxic substances
- Ensure maximum reuse and recycling of materials among EIP businesses
- Reduce toxic materials risks through integrated site level waste treatment
- Link the EIP to companies in the surrounding region as consumers and generators of useable byproducts via resource exchanges and recycling networks

d) Water

- Design water flows to conserve resources and reduce pollution through strategies similar to those described for energy and materials

e) Effective EIP management

- Maintains the mix of companies needed to best use each others by products as companies change
- Support involvement in environmental performance for individual companies and the park as a whole.
- Operates a site wide information system that supports inter-company communications informs members of local environmental conditions, and provides feedback on EIP performance

f) Building design and construction.

- Building design uses strategies for water energy efficiency and non-toxic materials. New construction or rehabilitation of existing buildings follows best environmental practices in materials selection and building technology. These include recycling or reuse of materials selection and building technology. These include recycling or reuse of materials and consideration of lifecycle environmental implications of materials and technologies.

3.2 EIP and the community

Any industrial park is interdependent with the community and it relies on it for human and material resources, services, and trade.

Industrial ecology is a dynamic system-based framework that enables management of human activity on a sustainable basis by:

- Minimizing energy and materials usage
- Ensuring acceptable quality of life for people
- Minimizing the ecological impact of human activity to levels natural systems can sustain
- Maintaining the economic viability of systems for industry, trade and commerce.

3.3 An EIP in context

The most important criteria for creating and maintaining an Eco-industrial park is linking its development with parallel initiatives in the larger community.

3.4 Methodology

Eco-industrial Park development raises new questions within the context of traditional industrial development processes. Developing an industrial park shall require several rounds of planning and design. The project feasibility itself gets detailed with each stage. The project must satisfy financial, economic development, public planning/zoning, environmental, and technical criteria at each step.

The Eco-industrial Park must follow the traditional process, while considering new design options in each phase of project planning. In terms of development, a strategic plan for dealing with all of the areas of concern is to be formed.

Ch. 4. About Auroville industries

4.1 Introduction

The emphasis of industrialization on sustainability, cleaner environment, reasonable exploitation of natural resources, achieving better human relations, are moving towards the realization of the aforesaid goals. Every industry in Auroville is working in pursuit of this vision in some way or another.

They participate in human relations, invent environmentally friendly techniques of production or participate in social development, apart from earning money for Auroville.

Industries in Auroville are mainly small-scale and pollution-free. Many of them deal with handicrafts. These 'business units', as they are called, either provide the basic material necessities for the residents of the community or generate income for the general maintenance of the township, while also sponsoring other projects for the community and in the neighboring villages.

4.2 Typology of industries

The experience of Auroville provides insight for sustainable development of industries. The development of industries should be a gradual process, keeping pace with the development of the community.

4.2.1 Produce first what the community needs

Aurovillians have expressed that ideally, identification of the genuine needs of the community and the attempt to satisfy those needs through production, should be the first priority. It is a step towards self-sufficiency and the community should have a reasonable size to support the service industries.

4.2.2 Produce from what is available in the region

The study of Auroville industries reveal that for sustainability, emphasis should be on making products, which meet the needs of the visitors and the residents from the locally available raw materials, found in the surrounding region only. It would be worthwhile to do a research for proper usage of the local resources for producing goods.

4.3 Regional resource

4.3.1 Regional Linkages

Auroville has the potential of being accessible to all-major regional nodes and cities either by road or by rail. Accessibility by various modes is available and it is used by the industries of Auroville to procure raw materials as well as for export. Strengthening of existing linkages and planning for the potential linkages will be help in the development of industries.

4.3.2 Natural resources

Ideally, raw material should be available within the immediate region of the industries. Most of the Auroville industries fulfill the raw material requirements from the surrounding region of around 300 km. Moreover they are studying the potential of resources in the region and the kinds of uses to which it can be put, so that the whole region can be made self-supporting. Resource-based studies for goods manufacturing can become the information for the setting up of new industries.

4.4 Income generating trusts and units in Auroville

Today there are around 125 active commercial units in Auroville involved in the fields of architecture and construction, clothing and fashion, weaving and dyeing, computers and software, electronics and engineering, media and entertainment, food processing and catering, handicrafts, renewable energy, pottery, printing and publishing, shops and boutiques, gems and jewelry, travel and tourism, etc. The ownership of all these units is vested in the Auroville Foundation.

4.5 Influence on village life

Apart from the Aurovillians, who work on a voluntary basis for a maintenance allowance, Auroville employs some 4,000 people from the local villages, whose work typically covers anything from agriculture to engineering, cleaning, gardening, driving, accounting, teaching, commerce and supervising.

There is also a blossoming of small-scale businesses, not belonging to Auroville, in the surrounding villages, like building contractors, handicraft workshops, taxi operators, boutiques, shops, etc, all of whom may have derived direct or indirect support from Auroville.

4.6 Turnover

In the year 2001-02 the total turnover of the commercial activities amounted to over Rs. 33.54 crores and total profits were about Rs. 5.19 crores. Of this turnover, about Rs. 12.48 crores were generated through exports. Incense and garments are the largest .The contribution of the commercial units to Auroville was around Rs. 2.54 crores, which is an average of around 48% of the profits. The contribution of the commercial units to Auroville Township helps it to maintain partially, its basic township services and infrastructure of roads, schools, health, waste treatment, arts and culture and township as a whole.

4.7 Work ethics

The work done and the goods produced in Auroville reflect a certain quality, since the units of Auroville are in a constant endeavor to reach material perfection, as a goal of the Auroville Charter set by the Mother. This concept is put into practice not only in regard to products, but also to all services and business ethics by Auroville units. This is evident by talking to workers and Auroville's business partners, who are constantly impressed by the work ethics prevalent here.

4.8 Innovation and Research

Industries can act as a cradle for research. Auroville industries conduct research in manufacturing environmentally friendly products and improving the quality of products through sustainable means. In this endeavor, some of them have innovated appropriate technology suitable for the local environment. Being an experiment, there are failures also but partial success in certain types of industries has been achieved. The industries should be motivated to do research and be innovative.

4.9 Present State of Existing Industries in Auroville

Environmental sensitivity and practice is a 'way of life' for Aurovillians. Each entrepreneur not only keeps an eye on the quality of his product but also traces the disposal of the waste, so that in disposal or in recycling, it may not harm the environment. In a few cases disposal of waste from a particular type of industry was found to be different from similar waste from another industry, as the former waste contained hazardous chemicals. Industries should be encouraged to keep watch on waste disposal and waste recycling.

4.9.1 Strengths

- Auroville located at a distance of 200 km, from Madras, enjoys relative proximity and good accessibility.
- Other regional nodes Salem, Pondicherry, Coimbatore are also accessible to Auroville [by rail/road]
- A philosophical vision to support Auroville's growth and development.
- Resource base was a group of Westerners who were creative, pioneering and entrepreneurial.
- A pool of labor was available as their occupation was primitive and included foraging for food.
- Afforestation empowered the women folk, and they became available for handicraft industries.
- Industries come under the Auroville Foundation, which is exempted from income tax.
- As ordained in the Auroville Charter, no immovable property is in private ownership and every fixed asset is the property of Auroville.
- The executive is the whole and soul of the unit and acts as manager, planner and strategist for the unit.
- The executives are autonomous enough to take any decision for the unit apart from certain restrictions on fixed assets.
- The boutiques in Auroville and Pondicherry display the articles.
- Most of the executives being westerners, export market was established through their contacts.
- Most of the units being export oriented there is no problem of getting paid on time.
- A variety of products are made under one type of raw material, it ensures usage of waste and leftovers

- The quality and perfection achieved, the variety offered and the design make every piece of handicraft a work of art.
- In terms of the use of local raw material, reusing waste and recycling makes the process sustainable.
- Auroville industries are labor intensive industries and consume little machine power and electrical energy
- The units are sensitive towards the use of hazardous material and proper disposal of hazardous wastes and reuse and recycling of the waste products is done
- Making quality products from materials that cost practically nothing and are locally available or from wastes.
- Every executive tries to do research in his/her own capacity and innovative to bring forth new products of processes.
- Being labor intensive, Auroville industries generate employment for the region, especially female employment.
- Each industry acts as an institution by providing some guidance and teaching to its employees.
- The industries being small scale there is assembly line but no division of labor, hence each worker knows the whole process.
- Auroville enjoys an excellent local support.

4.9.2 Weaknesses

- Very few of the entrepreneurs had prior knowledge about the respective craft and trade, so they had to start from scratch.
- Raw material available were clay, wood, grass, flowers, leaves etc.
- No skills existed among the local populace.
- No market existed in the beginning; being close to Pondicherry, a small number of visiting tourists were their clients.
- The scale of industries and agglomeration is too small to have forward and backward linkages.
- No outlet at the regional level.
- Less effort by individual executives to tap the national market.
- No effort in evolving a marketing strategy for Auroville products.
- No strategy for advertisement of Auroville products
- Very few industries follow any sales policy like 100% advance payment. There is lack of sales policy for the products

4.9.3 Failures

There have been some failures too in the economic development of Auroville, including that of cottage industries. Auroville's economy has not grown as it was envisaged in the beginning. Major areas in which it has failed to achieve success are:

- Self-sufficiency
 - Contribution by industries
 - Kind economy
 - Lack of institutional support
- **Self-sufficiency**

Inspire of growth of industries, Auroville is still not self-sufficient in many respects. One of the reasons stated is that population is too low to support self-sufficiency. Hence Auroville fulfills many of its requirements from the markets of Pondicherry.

- **Contribution by industries**

In the absence of adequate resident population, the industries that came up are basically manufacturer of goods and articles which are mostly sold outside and exported, thereby generating money from outside. Despite most of the industries being capital goods based and not services oriented, Auroville still depends on grants and donations.

- **Kind economy**

Inspire of experimenting with an in-kind economy for many years, Auroville has still a long way to go in order to achieve success in the practice of an in-kind economy. Moreover self-sufficiency and practice of in-kind economy are so inextricably linked that one cannot be achieved without achieving the other.

- **Lack of institutional support**

Since the beginning, Auroville entrepreneurs have lacked financial support (banking etc.), strategic or technical support from Auroville as an institution. Everything depended on the individual entrepreneur, which is also a risk for a town aspiring to be self-sufficient. Similarly, all the liabilities are thrust on the entrepreneurs and he has to fend for himself in case of losses suffered.

4.9.4 Innovation, Technology and Environmental Concerns

Amongst the cases studied, it is not that each unit is developing a new technology. Most of them are using old technology but the effort is towards using and evolving appropriate technology suitable for that area and environment.

In garment industries, crafts and processes used are conventional apart from appliquéd unit, which uses waste cloth pieces discarded by other garment industries as its raw material. Around 40% requirement of its raw material is fulfilled in this manner.

The units attempt to use environmentally friendly techniques and research to achieve quality without the use of hazardous chemicals. In the garment unit, the cotton used is organically dyed and it is ensured that exported garment is ASO free (ASO is a particular dye which was banned in Germany because it is hazardous to the skin and unsafe for children). The attempt is being made in leather craft to use only lacquer for coloring, but till now they have been unsuccessful in achieving the same quality with lacquer. The preservatives used in Jam-jelly are organic, made from flowers and not chemicals and Aurovillians have been able to grow the required flowers successfully in Auroville.

4.9.5 Achievements of Auroville industries

- Self-reliance and Sustenance
- Benefit to the nation
- Auroville Product Image
- Environmental Management
- Inter-linkages, Esprit de corps and Collective Realization
- Social Development
- Empowerment of Women
- Units as an Institution
- Programs and other benefits

Auroville has come a long way towards achieving self-sustainability since its genesis 30 years ago. The achievements of the Auroville industry are myriad and are enumerated below. From practically nothing, the number of Auroville handicrafts and small-scale industries grew to 50 units after 25 years and to 80 after 30 years. They have multiplied into such diverse activities as candle and incense making, pottery, gemstone jewelry, wood and stone work, stationery, construction and architectural services, printing and graphic design, fish farming, cheese making, leather products, garments, electronics and computers.

- **Self-reliance and Sustenance**

By far, the most significant achievement of the Auroville industries is the ability of an individual to support himself and the strides it has taken to make Auroville self-supporting. Earlier, residents had no means of subsisting in Auroville which had led to a transmittal economy in which they had to work for a certain period in their respective countries in order to earn money and thereby survive in Auroville. This had forced Westerners to try and set up some enterprise so that they could stay with their family and gradually some of them have achieved a high degree of success.

The success of the units in Auroville has also led to the self-sustainability of the Auroville economy. If we can compare the grants and donations with the gross turnover of these units, it can be seen that since 1988, the growth rate of turnover of the units has been quite high. It varies from Rs. 150 lakh in 1988 to Rs. 880 lakhs in 1992 and to Rs. 1900 lakhs in 1997. The dependence on grants and donations has been reduced as the rate of growth of turnover and the profits increased, gradually exceeding that of grants and donation. This graph can also be interpolated before 1988 which shows that Auroville took 24 years from its inception to generate enough funds to match the donations and grants. In 1995, the share of profits made by the units contributed 50% of the running expenses of Auroville.

The success of individual units can also be gauged from the fact that profits are also increasing in magnitude from around Rs. 38.42 lakh in 1988 to Rs. 218 lakh in 1992 to around Rs. 350 lakh in 1997.

- **Benefit to the nation**

In terms of monetary benefits, Auroville managed to bring in foreign exchange worth Rs. 10 crores, of which Rs. 6.5 crores was from the export earnings of the business units. It has also disseminated knowledge and technology gained after many years of applied research to Indian professionals and people through workshops, seminars and conferences.

- **Auroville Product Image**

The products of Auroville are synonymous with qualities like sheer excellence and craftsmanship, innovation and sensitivity towards environment. This has resulted in establishing a brand name for Auroville products and they have created a niche in today's competitive markets which future industries of Auroville can build upon.

- **Environmental Management**

One of the guiding principles of the Auroville experiment is that of sustainable development in all endeavors. A high consciousness of this principle is reflected in their approach. The Aurovillian units have succeeded in this with a fair amount of success.

In most of the industries studied, ways have been evolved in which to put the waste products to some use or other. In some industries, the waste from one unit forms part of the raw material for another, e.g. A garment unit, an applique unit, 40% of whose raw material is sourced this way. Maximizing the use of raw materials and minimizing waste is another feature of some units. For example, a leather workshop makes products varying from big carry bags to wallets and key chains. Similarly, it has been found that a greeting card unit, uses flowers from their own backyard as well as leaves and grasses from the neighborhood.

Some industries have altered their production process to be sustainable; for example a pottery unit fires its pottery at 1300C rather than 800C, just because, at the lower temperature, toxic lead compounds are produced while at 1300C, they are rendered harmless. All garment and cloth based industries either sell their waste pieces to workshops as scraps or use them for making handmade paper. Auroville also has an Eco service Unit, which collects all non-recyclable elements like glass, plastic etc and practically all the wastes are accounted for.