Sustainable Living in Auroville

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I. Introduction

The topic of sustainability is at the forefront of current international discussions. The rising importance placed on green practices has been prompted by the rapid depletion of natural resources, and the increased anthropogenic interference in the natural climatic balance. Private and public research institutions and bodies are continuously researching and working on innovative technologies and systems which are environmentally viable for the today's society, and Auroville is a part of this pursuit for a sustainable future.

At the inception of Auroville in 1968, the founder - Mirra Alfassa (referred to as 'the Mother' within Auroville) was concerned with creating a unique community that would integrate social, spiritual and environmental consciousness in its growth. This social consciousness, alongside the natural environment has created the ideal experimental community for innovation and design.

This report sets out to explore the various dimensions of sustainable living, practices and planning processes in Auroville. By highlighting the innovations and sustainable processes of the experimental community, policy planners, non-government organizations and socially conscious individuals alike can integrate applicable practices into sustainable and green practices on all levels.

Auroville's Natural Terrain

In 1968 when the plan for the international spiritual community was unveiled, the chosen site was a barren plateau surrounding by impoverished villages in the South Indian state of Tamil Nadu. Given the dry and over-cultivated land chosen for the future settlement, innovative planning and design (from large-scale reforestation, ground water recharge processes, etc) was required to convert the land into the Aurovillian dream. Today, Auroville's landscape stands as a testament to the tremendous investments of time and money dedicated to attain its green and natural habitat.

Auroville's Social/Spiritual Consciousness

The tenets of Aurovillian living are centered on the concept of inner consciousness by the unity of the mind, body, and nature. As a result, there is a very evident social consciousness of the entire community towards sustainable and green living. The core of planning on both the top level and bottom level centralize themselves around the principles of "true living (through) simplicity and harmony in usefulness"[1] offered by the Mother. Simplicity in reference to the life style choices and tastes of the Auroville society, and harmony in usefulness in reference to the use of technologies which would complement the local terrain and natural forces.

[1] Quotes from 'the Mother' in Gilles' memo on 'The Planning of Auroville'

Structure and Set-up of Auroville

The grand plan was to create two geographic regions around the Matrimandar. The first region - City Area was planned as the core of Auroville society, and would contain the residential houses, and core community centers. The second region - the Green belt was a planned forest area that would surround the City Area. . The green belt had the dual function of adding greenery and beauty to Auroville, as well as serving as a region for food and raw material production. The areas outside the green belt are largely rural communities and uncultivated land (although Auroville also owns some property around the area).

Residential quarters within the City Area are organized into communities. By organizing the residencies in this manner, Auroville is able to build itself around this simple and harmonious idea of living since smaller communities reduce the need for construction and maintenance of large-scale (and somewhat inefficient) municipal systems. Aside from electricity supply, the communities are usually self-contained with localized water and wastewater management systems (although there are some communities such as Verite and Pitchandikulam which are fully self-contained and are not connected to the grid).

II. Sustainable Technology and Design in Auroville

Sustainable Technology

Technology plays an important role in the pursuit for sustainable living. Within Auroville, several research institutes are continuously working on innovative processes to reduce energy and water use by modifying and integrating new and existing technologies.

Solar Technology

Solar technology is widely used within the various communities and is the largest renewable source of energy in Auroville. The most common application of solar technology is for water pumping, water heating, street lighting, and in some cases electricity generation.

Solar Electricity

Some communities and buildings run completely on electricity produced by photovoltaic (PV) panels. The PV systems used within Auroville are custom designed by Aurovillian groups, and integrate inverter and battery storage systems for cloudy and rainy days. Currently, there are 400 houses running solely on solar electricity within Auroville.

Solar Water Pumping and Heaters

Over 80% of the solar technology in Auroville is used for water pumping and heating. Many of the operations for the waste water systems, and well/boreholes rely on this form of energy to move the water. Aurovillian solar service and solution experts have formulated simple and low maintenance pumping and heating systems.

Box 1: Solar technology in practice: Auroville Solar Kitchen

The largest and most striking use of solar technology in Auroville is the Solar Kitchen. The concept of the Solar kitchen came out of the desire for a practical and sustainable communal space within Auroville. Currently, the kitchen serves approximately 1000 lunches a day

The kitchen's power system is designed as a hybrid system (solar and diesel run) with the diesel system stepping in when the solar energy generation is too low to support the kitchen operations.

The **solar system component** is a solar bowl design, which uses hundreds of mirrors to focus sunlight onto the heat receiver. The coils around the heat receiver are filled with water and when the water turns to steam, it is pumped below into a boiler room, and used for the cooking operations. The solar bowl is currently the largest in the world.

The **diesel system component** was installed to replace an inefficient, high maintenance and dangerous solar storage system which was initially installed.

Many of the cooking utensils have been customized to suit the needs and system of the solar kitchen.

Wastewater Technology

The Center for Scientific Research (CSR) has applied innovative methods to customize the available wastewater technologies to fit the various Auroville community needs. The CSR wastewater systems designs are based around tenets of simplicity, affordability, and need for minimal energy input.

To avoid the inefficiency and high cost of municipal wastewater management, the CSR has adopted various techniques of Integrated Decentralized Waste Water Systems. The systems consist of underground containment and pre-filtration tanks, and overhead oxygenating and polishing ponds. For commercial and urban spaces that have little space for ponds, the institute has designed a cylindrical vortex system which takes advantage of centrifugal and centripetal forces to filter and oxygenate the water. The resulting 'gray' water from the system may then be reinserted into the water table, or used for local irrigation purposes.

Another technology used for wastewater treatment is Effective Micro-organisms (EM). EM is an organic liquid composed of microbes, which quicken the decomposition of waste and compose. When effectively added to waste water, it reduces the amount of sludge in the black and grey water.

Electric Vehicle (EV) Technology

A large portion of the energy consumption in Auroville is spent on transporting people and goods. To reduce their carbon footprint, and create a healthier natural environment, Auroville is looking to expand the use of electric vehicles (small electric cars, electric bicycles and electric motorcycles).

There are various working components to successfully integrating electric vehicles into the community.

1. Central to the success of EV is the **installment of charging points at convenient locations throughout the community**. Currently, plans are being hashed out to install charging points between the City area and Green belt area and the major obstacle facing designers is finding cheap but green options for operating the charging points (preferably having the points detached from the central grid).

2. **Awareness campaigns around the advantages of EV** over the currently used petrol motorcycles and mopeds are also important for the successful implementation of the EVs. However, one major challenge to full EV adoption is the number of EVs that would be required to replace existing vehicles. To address this issue, designers within Auroville are researching methods to

    a. Effectively convert current vehicles into EVs.

    b. Create an integrated transportation scheme that will optimize shared rides, bicycle loans, and public transportation.

Wind Technology

Few projects and communities within Auroville take advantage of wind technology for energy production. The few projects that do take advantage of this renewable technology use the power generated solely for their water systems (see **Error! Reference source not found.** for more details).

Although wind energy is not a viable resource for constant energy supply within Auroville, exploration and integration of this energy source in the Auroville energy mix has the potential to further reduce reliance on non-renewable energy inputs

Sustainable Design

Looking at design from a sustainable angle involves incorporating and utilizing the natural environment into planning and design. Architects, planners and product designers within Auroville have centralized the core of their innovations around sustainable design.

Product Design

Products designed on any scale require careful design to effectively optimize its usefulness, and reduce its environmental cost. A lot of thought and creativity is put into the design process in Auroville, and integral to the creation processes is

1. **Understanding the exact need of the product.** Thoroughly understanding the consumers' needs will substantially increase the utility gained and the lifespan of the product. The product of a sustainable design should integrate practicality, and usability into its design.

2. **Using local and high quality input.** The aim of sustainable design is to reduce the embodied energy of a product. The most effective approach to reducing energy consumed is the use of local input. Designers sometimes face the dilemma of prioritizing the use of local input or high quality input, and an effective designer's job is to creatively find the balance between the two.

3. **Effective logistics**. The production stage does not mark the end for a sustainable product design. It is important for the product designer to incorporate supply logistics into the design and production process. The location of production and supply chain are one of the many logistic concerns that must be thought through by the product designer.

Architectural Design

Architecture and design within Auroville is highly experimental around natural architecture. Natural architecture takes advantage of local available building materials, as well as the layout and contours of the project site. By effectively planning the building design, the architect can take advantage of the natural lighting and wind direction to reduce the need for artificial lighting and cooling systems.

There are two main inputs that are being experimented with in Auroville – ferro-cement, and earth blocks. Experimentation and development within the Center for Scientific Research (CSR) and the Earth Institute on these two building materials, has increased the durability and functionality of the materials.

Box 2: Building Materials: Ferro-cement and Earth Blocks

Ferro-Cement

Ferro-cement is made using chicken mesh plastered in mortar (cement, sand and water). Since ferro-cement requires less material than reinforced cement, it is largely preferred over conventional cement for construction.

Aside from the economic advantage, ferro-cement is also very flexible and is the appropriate material for 'niche applications'.

Ferro-cement is ideal construction material for infrastructure that is periodically/seldom used, and requires minimal design intricacies (such as school buildings, religious buildings, etc).

Currently, the cement industry contributes about 5% to global CO_2 levels. A wider scale adoption of ferro-cement in construction can therefore lead to significant reductions in CO_2 emissions.

Earth Blocks

Earth Blocks (or eblocks) are building blocks made of soil, sand, and 5% of cement mixture. The eco-friendly blocks are produced by first mixing the components with water, manually compressing them with customized presses, and cured for approximately 28 days to reach a 'dry compressive strength of 7.5 MPa"[1]

Aside from the eco-friendly input used in the production process, the use of localized inputs (soil from the site surroundings) immensely reduces the embodied energy since there is less need for transportation, mechanized block production, and firing processes amongst others. According to the Earth Institute, embodied energy for a finished wall (in MJ/m^3) made of eblocks is 19 percent less than concrete solid blocks, and over 70 percent less than fired brick.

Other benefits of eblocks include the aesthetic earthen look it naturally possesses, humidity regulation provided (with proper planning and design), and the low maintenance it requires in the long run (versus cement plastered walls which require periodic re-plastering and painting).

For more information on eblocks, please visit www.eblockindia.com

Architectural design is also centered around maximizing the utility of spaces by integrating functionalities into common spaces. By efficiently designing the building/infrastructure, it is possible to decrease the required building area (and effectively the cost and embodied energy of the project) by approaching design in this fashion. Sustainable architectural design must incorporate the following aspects:

1. **Understand the basic requirements of the users**. The process of 'understanding' involves questioning the 'whats', and 'whys' of the users' requirements. By thoroughly understanding the users' requirements, the architect can effectively reduce the building area by designing multi-functional and multi-purpose spaces.

2. **Include user/client(s) in the design process**. Active participation by the user/client is integral for incorporation of sustainable designs within the building.

3. **Integrate building systems.** An efficient building design should seek to integrate various systems and functions within the building. From rainwater harvesting systems, to water management systems, landscaping, etc

4. **Use sustainable building input.** A sustainable design should make use of materials with low embodied energy while also being conscious of the long-term maintenance requirements for the user.

5. **Take advantage of the natural terrain.** Understanding the natural terrain of the site and creating the design to effectively address and/or utilize the qualities of the environment can substantially reduce the energy use of the building.

Box 3: Sustainable Architectural Design: Landscaping and Rainwater harvesting

Landscaping

Landscaping is an important part of sustainable architectural design. Landscaping serves the dual purpose of adding to the aesthetics of the building, as well as preserving and managing the soils properties. Based on the type of building, and the preference of the clients, landscaping can also incorporate small polishing ponds (from waste water system), and orchards and gardens.

A sustainable landscape incorporates local/indigenous plant and tree species that require little maintenance and watering for growth.

Within Auroville, the building/infrastructure architect commonly designs landscaping. One major advantage of this integrated planning is that it allows the architects to be mindful of the landscaping space.

Rainwater Harvesting

Building designs has begun to incorporate rainwater harvesting into structural design. Prompted by the alarmingly decreasing rate of the water tables in the area, the inclusion of rainwater capture and storage facilities has become highly common in Auroville.

After rainwater has been captured, it can be redirected to the water table (through various means such as percolation gardens), or can be used for household and building activities.

III. Sustainable Practices and Processes in Auroville

Governance and Planning

Governance matters for effective sustainable planning. The Planning Committee of Auroville is the body charged with organizing the resources and overarching policies within Auroville.

Rather than act as decision makers, the planning committee members act as facilitators that ensure that the direction of projects are geared towards the direction of the Auroville vision.

As much as possible, the Planning Committee advocates that input and services be provided on a local level. The preference for localization of input and services stems from the aspiration to increase local capacity and expertise, as well as reduce Auroville's carbon footprint.

The Planning Committee also works on developing and encouraging cross-sector integration. By taking advantage of potential synergies between working sectors in Auroville, the planning and operations within Auroville can reduce duplicated efforts, reduce incurred costs, and produce more sustainable development and design within Auroville.

Integration of sustainability

The concept of sustainability permeates Auroville on all levels. Many research projects, design processes, and infrastructural developments are initiated in response to sustainability challenges. However, the various sectors are very segregated with little coordination and duplicated efforts in the various working groups. Efforts to consolidate and integrate research and construction projects have recently been initiated because of this inefficiency.

Integration within Auroville tends to occur on two levels namely – integration on the project level, and integration on the sector level

Sector Level Integration

The integration of sustainability on the sector level seeks to consolidate and coordinate efforts within the various sectors within Auroville. Consultants working on sector level integration began by dividing Auroville into 18 working sectors (food, education, transportation, natural, infrastructure, water, etc). The concept behind creating these 18 specialized sectors was to allow for holistic planning of development within Auroville with each sector having an input in the direction and planning of projects related to their sector.

Currently, the working sectors are working on a 5-year development plan for Auroville. The collaborative planning on this level will immensely reduce planning shortfalls such as dead-spots, infrastructure and settlement segregation, as well as reduce incurred costs on large scale projects within the communities.

Project Level Integration

There are many efforts to also integrate and create synergies amongst the various groups and working divisions within Auroville. An Aurovillian company called Auroville Consultants has developed a strategy that will improve the collaboration process on the project level within the community. Based on a refined framework they term 'Green Practices', the firm seeks to create

institutional partnerships within (and outside) Auroville that create solutions based on the Green Cycle (the Green Cycle refers to the integration of innovation and development within the Agro, Water, Forest, Energy, Habitat, Waste and Outreach sectors).

The integration of sustainability on the project level has also lead to discussions and research within Auroville on how to create economical and psychological incentives to promote sustainable and 'green practices' in the surrounding communities.

Forestry

Arguably the action taken by Auroville that has had the largest impact and is the most sustainable is the reforestation that they have instigated over the last 30 years. This development has resulted in the increase in water table levels, increased natural resources in the form of a self-sustaining forest in the place of barren wasteland, and the sequestration of a considerable amount of carbon by the forest itself.

One essential key to the reforestation process is the integration of tools and techniques to prevent erosion and increase soil fertility. To accomplish this, Auroville employed extensive bunding methods. The bunding process involves the creation of small mounds of earth walls around strategic locations with the purpose of keeping rainfall within the small entrapments they form. Once the rain is caught, the natural process of percolation absorbs the rainwater into the soil. The simplicity and lack of resources required for bunding makes the process highly appealing and well practiced within the community.

Daily Green Practices

The day-to-day operations from the individual level, to the organizational are centered around green practices. Although most of these practices are simple, they have large impacts on the environment in both the short and long run. Some of these practices include

1. **Garbage separation**. Separation of garbage based on it's bio-degradable nature allows the garbage to be reused for compost (fertilizers for gardens and lawns), or recycled.

2. **Lavatory and Eco-sanitation.** Lavatory and eco-sanitation refers to the segregation and use of excreta for agriculture fertilizers. Fertilizers produced from these materials are cheap, and good for garden and orchard applications. Communities such as Sadhana forest currently use this practice.

3. **Community recycling and reuse projects**. Examples of these projects include the Auroville central 'exchange' shop. Instead of dumping old and unwanted items in the garbage, community members are encouraged to exchange or donate these items to the shop since another community member may find the item useful. Reuse projects such as

WELLpaper (organized by the Auroville unit called Women Empowered through Local Livelihood) use old newspapers and other unwanted items and create crafts and jewelry that are sold for profits.

4. **Communal facilities and communal schedules.** The idea behind schedules and common facilities for the community is rooted in the desire to reduce the energy consumption of the community. For example, offices within Auroville have similar tea time schedules. Since the tea preparation is done in bulk, less electricity is used in the preparation of the tea. Simple practices such as this are effective in saving energy and creating a energy-conscious community.

5. **Discouraging and replacing plastic bags.** Since plastic bags cannot be recycled or composted, they are environmentally unfriendly. Replacing plastic bags with paper bags, and encouraging the use of recycled shopping bags reduces the litter accumulation within the area while also saving money in the community.

6. **Green messages.** Planting green messages in various places increases the community's environmental consciousness. Green messages are placed in strategic locations (communal kitchen, bulletin boards, some packaged produce, etc).

Education and Community Engagement

The Auroville community has had enormous social and economic impact on the surrounding villages. Currently, over 5000 villages are hired from the villages as laborers and service providers - villagers are hired as cleaners, construction workers, maintenance workers, and are given on the job training. While some of these jobs may be considered menial, the increased family incomes have substantially increased the standard of living within the communities. .

Auroville also coordinates several outreach programs to compliment the economic growth of the surrounding communities.

Education Programs

Auroville currently runs several schools for children from surrounding communities. The school curriculums are somewhat experimental, and place equal focus on academia, environmental consciousness, social interactions and diversity. The medium of instruction is English and/or French.

Vocational Training

Vocational training is offered to older members of the community for training in sustainable trades such as recycled crafts, organic farming, instrument making, compressed earth blocks production, herbal medicine and other such industries.

Health and Environmental Awareness

Health and environmental awareness campaigns are usually integrated into the education and training programs offered by Auroville. Villagers are shown simple and practical ways of living healthier lives, cleaning and maintaining their environment, and hygienic reusing their waste materials and animal excreta.

Box 4: Verite Community: An embodiment of green living

Verite is a small Aurovillian community, which has adopted the tenets of simple living in all aspects of its operations. The relatively small size of the community has been integral in the successful incorporation of the various sustainable

Living Quarters are made primarily of earth blocks and are small and relatively close together with many sharing communal lavatories and showers. Water is drawn using a wind-pump, and rainwater is collected for communal use and agricultural purposes.

The community's landscape consists of a large garden for herbs and vegetables, and an orchard with numerous indigenous and foreign fruit trees. The waste water system cleans black and grey water for irrigation in the garden and orchard.

There is a communal kitchen where food and tea is prepared for the entire community. The waste from cooking is composted for fertilizing the orchard and garden.

Verite is completely off the municipal grid, and meets its electrical demands by energy generated from a PV panel system. The system is hooked up to a battery bank which holds enough electricity for night time and cloudy days.

In essence, the Verite community is an embodiment of all the principles of sustainable living. The ability of the community to fully incorporate green practices requires individuals with encompassing passion and dedication to the principles of the unity of human and nature.

IV. Avenues for Design and Technology Transfer

The rapidly changing environment caused by increased anthropogenic activities necessitates a change in environmental awareness, and sustainable living at all levels of society. There are potentially many lessons and practices from Auroville that can be adopted to effectively increase sustainable living consciousness within rural India.

Outreach and sustainable living campaigns

The foundation for the successful implementation of green practices requires a mindset change within the rural communities. Institutions such as IFMR with local connections and high regard can play a large role in facilitating the outreach programs and campaigns.

Effective outreach programs and campaigns should not only focus on education, but also allow for interaction with community members on feasible sustainable projects that can should adopted. In the long-run, the outcome of outreach and campaigns should prompt behavioral changes and environmental conscious living within the communities.

Vocational Training and Sustainable Livelihood Projects

Training centers on sustainable livelihoods and startup capital for these businesses is a viable option for non-profits to increase the living standards of rural communities, as well as promote sustainable practices. Community members may be trained in earth block production, recycled crafts, solar and wind maintenance, etc.

A potential option to recuperate initial investments into this venture is a profit sharing and management system where the organization is initially involved in the management of the business with the option of fully handing operations to the individual(s) once the business is fully grounded and/or the initial capital investment has been recuperated.

Infrastructure Investments

There are several sustainable systems which can be adopted within rural India namely: waste water management systems, and sustainable architectural design. It is important to engage the community in dialogue before initiating or designing programs or systems as the long-term success of these projects depends on the understanding and commitment of the community to the program/system.

Dialogue is also important for designing effective systems that take the natural terrain and local dynamics into account. Installation of technology and infrastructure within rural communities should be simple and require minimal maintenance and input.

V. Conclusion

The success of the Auroville experiment has highlighted the import of integration of all sectors and all levels of planning and design for successful sustainable living. As the international community continues to intensify the promotion of technology and processes to reduce anthropogenic carbon levels, and conserve natural resources, the Auroville model presents a simple and innovative model for sustainability.

A top-down and bottom-up approach is essential for the successful implementation of sustainable living practices in developing countries such as India. Effective top down policy should involve economic incentivizing for green and renewable technologies as the current costs of these technologies dis-incentivize their adoption within rural areas. Decentralized planning of community facilities such as water facilities, wastewater plants etc is also a more eco-friendly

approach to sustainability. Currently, in India there are very few and highly ineffective policies that encourage sustainability within the rural communities. Institutions such as IFMR Trust can step in to advocate for more effective policies for these communities

An effective bottom-up approach must center on education of sustainability within the rural communities. Without the appropriate understanding of the need, implications and benefits of sustainable practices and processes, policies and projects are unlikely to be successful in the long-run. Social experimentation[2] has shown that education coupled with strategic social and emotional campaigns is an effective way of prompting behavioral change.

As global temperatures continues to warm, sea levels rise, and natural resources become even scarcer, communities in rural India and the rest of the developing world are the most vulnerable to associated climatic change. Sustainable development must therefore place modification of rural unsustainable practices at the top of political and social agendas as failure to do so may lead to issues that have the propensity to accumulate into civil unrest and conflict.

[2] The social experiment being referred to is the Bogota experiment carried out by Mayor Mockus of Bogota, Colombia. For more information, see www.worldchanging.com/archives/000483.html